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AN ECONOMIC INVESTIGATION OF THE MONTANE TUSSOCK-GRASSLAND OF NEW ZEALAND.

XII. THE REGRASSING EXPERIMENTS IN CENTRAL OTAGO.

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PART I.—AN ACCOUNT OF THE DEPLETED AREA IN RELATION TO THE EXPERIMENTS.

THE ultimate object of the tussock-grassland investigation is to discover payable methods by which the carrying-capacity of that class of pasture could be increased to the utmost. This resolves itself at once into two distinct problems—namely, the improvement of areas where, though the vegetation is abundant, its feeding-value is comparatively trifling (say, one sheep to 3 acres at most), and the actual regrassing of country now so strongly depleted as to contain far more bare ground than plants of any kind. This latter problem should, apparently, be less difficult of solution than the former, since it is obviously easier to establish plants on bare soil than to secure a footing for such on ground already closely occupied by a plant-covering. But, as will be seen, the conditions under which regrassing must be carried out in the worst-depleted areas are so extremely severe that, at first thought, the problem appears beset with almost insuperable difficulties.

Depletion of the tussock-grassland, more or less extensive, occurs in various localities throughout the South Island, but it has reached its climax in the upper basin of the River Clutha (Central Otago),* while considerable areas of the Mackenzie country (Canterbury), and places here and there in the upper valley of the Awatere and the mid-valley of the Clarence (Marlborough), are strongly depleted.

In certain articles of this series† more or less has been said on this subject of depletion, but here, in order to bring out clearly the main features of the problem, together with the reasons for the methods devised for its solution, a certain amount of recapitulation becomes necessary.

As the regrassing experiments are confined to one portion of Central Otago, that area alone—some half-million acres in extent—is the subject of what follows. Further, as at above an altitude of about 2,500 ft. or 3,200 ft., according to aspect or other conditions, there is still a close vegetation of tussocks and other plants, this article is only concerned with the basal portion of the mountains, and does not deal at all with the subalpine grassland. In order to make quite plain all that pertains to the regrassing experiments the subject is divided into three parts. This—the first part—deals with the conditions governing the problem which the experiments are designed to solve; the second part will treat of the various objects, principles, and methods adopted for its solution; and the third part will give an account of the results of the experiments up to May, 1922.

In what follows it must be understood that the experiments are not designed to regrass any particular piece of land, but to find out the principles, methods, and suitable plants upon which regrassing depends, or to show that regrassing is impossible as a payable proposition. They are "experiments" in the true sense of that word, and not "demonstrations," though should plants of pasture value become established in reasonable time and in sufficient numbers, then they could be used for the latter purpose.

THE ORIGINAL AND PRESENT CONDITIONS OF THE MOUNTAIN PASTURES OF THE UPPER CLUTHA.

Originally, as in so much of the South Island eastwards of the average westerly rain, the valleys and hillsides of the upper Clutha river-basin, now depleted up to 3,000 ft. altitude (more or less), were clothed with a fairly dense covering of tussock-grassland. The dominant member of this association would, as elsewhere, be the fescue-tussock (*Festuca novae-zelandiae*), while the more palatable tall blue-tussock (*Poa intermedia*), blue-grass (*Agropyron scabrum*) in its many forms, and plume-grass (*Dichelachne crinita*) would occur in considerable quantity. There would also be present some smaller indigenous grasses,‡ some of which would be—the mountain-bent (*Agrostis Dyeri*), the Otago bent (*A. Petriei*), the Otago danthonia (*Danthonia Buchanani*),

* Outside this area there is much depletion in Central Otago.

† See, especially, No. 111, Notes on Depletion of the Grassland, this *Journal*, Vol. xix, Sept., 1919, pp. 129–138.

‡ For an account of the condition of the pastures and details regarding the species see D. PETRIE, Report on the Grass-denuded Lands of Central Otago, Bull. No. 23 (n.s.), N.Z. Dept. Agric., 1912, pp. 1–7.

FIG. 1. VIEW OF THAT PART OF THE DUNSTAN MOUNTAINS WHERE THE EXPERIMENTS ARE BEING CONDUCTED.
Note the dune-like appearance of the depleted slopes. On the flat ground is seen a crop of lucerne, the result of irrigation.
[*Photo by W. D. Reid.*

the oat-bent (*Deyeuxia avenoides*), and various herbs and semi-woody plants usually of no pasture value.*

Certain more or less leafless shrubs would be dotted about here and there, especially the thick-stemmed broom (*Carmichaelia Petrieï*), the Dunstan broom (*C. compacta*), the shrub-porcupine (*Hymenanthera dentata* var. *alpina*), and the wild-irishman (*Discaria toumatou*), the two last-named species being still quite common. Probably there would be a

FIG. 2. FINAL STAGE OF DEPLETION ON THE DUNSTAN MOUNTAINS, THE SCABWEED HAVING BEEN ERODED AND BLOWN AWAY.

[*Photo by L. Cockayne.*

good deal of the spaniard (*Aciphylla Colensoi*), which would form thickets. In short, except that the pasture would never be of extreme density, its general appearance and composition would be much the same as in any undepleted part of the South Island at the present time, except that all foreign plants would be absent.

On shady slopes and in the bottoms of gullies there would be, as now, but in greater quantity, rather tall shrubland composed of wild-irishman, odorous tree-daisy (*Olearia odorata*), and bushy tree-daisy

* There would certainly be the aniseed (*Angelica montana*), a plant of high palatability now almost extinct in New Zealand generally, but still abundant where protected from stock.

(*O. lineata*),* while climbing over them would be dense masses of the tangle-vine (*Muehlenbeckia complexa*). Also, the wild-irishman would make impenetrable thickets on the deep rich soil of the valleys, where also would occur the thick-stemmed broom.

At the present time the scene is changed beyond recognition. Gone altogether is the brown mass of tussocks, and with it have disappeared nearly all the members of the ancient grassland. Viewed from a distance the mountains resemble giant sand-dunes (see Fig. 1). A closer acquaintance, however, shows that on sunny slopes this is due to the surface of bare hard soil, in places destitute of all visible plant-life (see Fig. 2), but usually having growing upon it in their thousands, at from a few feet to several yards apart, the large, flat, hard, silvery, circular cushions or mats of the scabweed (*Raoulia lutescens:* see Fig. 3). Accompanying the latter are the thinner open mats of the Otago raoulia (*Raoulia apice-nigra*), and occasionally the rather denser ones of the common raoulia (*R. australis*). Near Pembroke the soft silvery mats of the desert-raoulia (*R. Parkii*) take the place of the scabweed, and there are abundant dull, whitish-green, hairy, soft cushions of the cushion-pimelea (*Pimelea sericeo-villosa*). A few lowly or inconspicuous plants accompany the scabweed, particularly the small, tufted desert-poa (*Poa maniototo:* see Fig. 4), small brown mats of the mountain-chickweed (*Stellaria gracilenta*), and tiny hard brown cushions of the desert-colobanth (*Colobanthus brevisepalus*). Slightly more favourable conditions allow the presence of the following: Green mats of the desert-sedge (*Carex resectans*), small tussocks, much eaten, of the Otago danthonia (*Danthonia Buchanani*), glaucous-green mats of pale piripiri (*Acaena Buchanani*), tufts of yellow oxalis (*Oxalis corniculata*), the small erect St. John's wort (*Hypericum gramineum*), the slender reddish grassland-willowherb (*Epilobium Hectori*), and the slender poa (*Poa Lindsayi*). All the foregoing are indigenous perennials with but little leaf-surface exposed to evaporation and small light seeds easily blown along the ground. Their roots are generally short, so they must depend for water chiefly upon the irregular scanty supply brought by rain.

There are other indigenous perennials, but usually far apart. The most important, in view of regeneration through spelling, are occasional small plants, usually much eaten, of blue-grass and tall blue-tussock, which are to be found only after a most careful search.

As for the palatability of the common species of the depleted ground, though certain of them—even the little desert-poa and the mountain-chickweed—are eaten to some extent, the value of the association as pasture must be almost negligible. It is the presence, in many situations, of an abundant crop of sorrel (*Rumex Acetosella*) which is the redeeming feature. Though always cropped as close to the ground as possible, this plant, thanks to its underground stems and deep-rooting system, is growing all the time, and must yield far more food than might be imagined.

On darker faces the soil is more open, but even under the moister conditions these supply, except where colonies of Californian thistle

* Almost a tree; it is frequently called "tea-tree" in Southland, notwithstanding the true tea-tree (incorrectly spelt "ti-tree") is the manuka (*Leptospermum scoparium*). Lower down the Clutha valley the bushy tree-daisy is abundant and forms almost pure thickets.

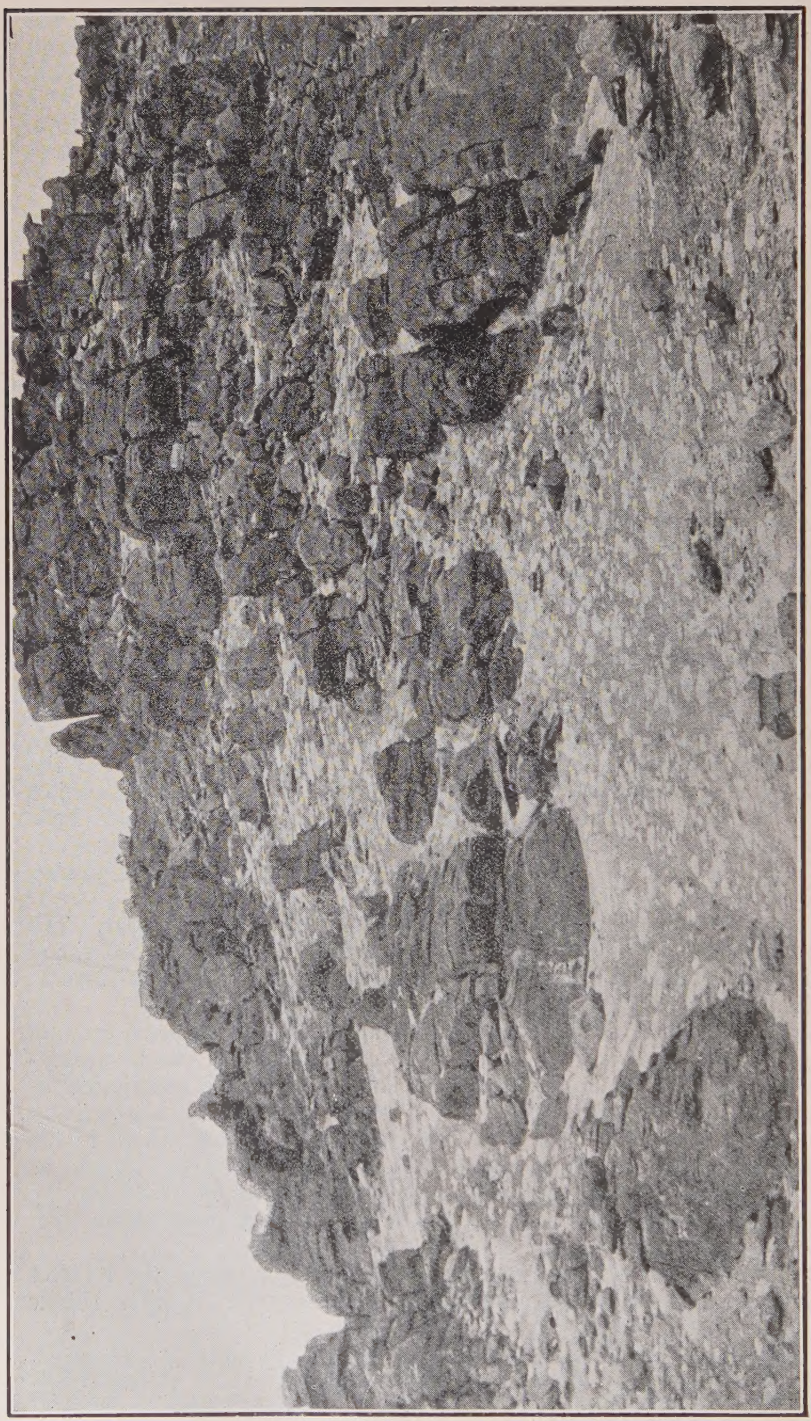

FIG. 3. VIEW OF A SLOPE ON THE EARNSCLEUGH STATION, SHOWING THE SCABWEED STAGE OF DEPLETION.
[*Photo by W. D. Reid.*

(*Cnicus arvensis*) occupy the deepest richest soil, the ground is bare enough. The only places where there is a continuous turf is on the banks of streams in the gullies, where there is a narrow belt of fiorin (*Agrostis alba*), in the occasional bogs, or close to huge outstanding rocks. These themselves are havens of refuge for certain of the former pasture-plants, especially blue-grass, plume-grass, tall blue-tussock, and spaniard.

In the bottoms of gullies, and on their dark sides, are the shrubs already mentioned as occurring in the original vegetation, but in many places they have been supplemented by the introduced elderberry (*Sambucus nigra*) and the sweetbrier (*Rosa Eglanteria*). Dark-coloured, rigid, cushion-like bushes of the shrub-porcupine are here and there on the driest ground, and they play a part in catching soil where seeds germinate. The thick-stemmed broom—characteristic of Central Otago—is usually eaten to the ground or much damaged; it apparently likes rather deep soil.

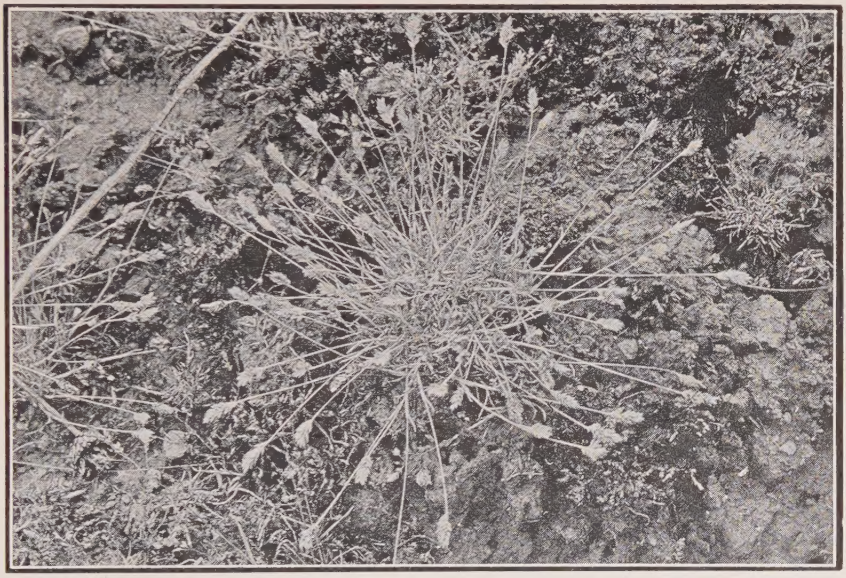

FIG. 4. THE DESERT POA (POA MANIOTOTO), ABOUT NATURAL SIZE.
This grass is abundant on the depleted slopes.
[*Photo by W. D. Reid.*

Near the upper limit of the area of depletion dead tussocks of tall blue-tussock appear; then, as one ascends, moribund tussocks put in an appearance, until, finally, healthy plants appear and the sub-alpine tussock belt is encountered.

Where the climate is rather wetter than in the driest part of the area certain species of piripiri (*Acaena*) form most extensive colonies, as on Mount Pisa, but, above all, near Cardrona.

Besides the perennial flora just described there is in spring one of another type, made up of annuals, which rapidly appear in such profusion that for a brief period many mountain-slopes and valley-floors, desert-like for most of the year, become green and look quite fertile.

This vernal flora is of considerable economic value, since it contains a number of palatable plants, easily the most important being the wild-geranium (*Erodium cicutarium*), easily recognized by its rather feathery leaves and small pink (or sometimes white) flowers. The following-plants are also members of the association: Foreign—soft brome-grass (*Bromus hordeaceus*), sterile brome-grass (*B. sterilis*), barley-grass (*Hordeum murinum*—also valuable in winter), annual fescue (*Festuca myuros*), hair-grass (*Aira caryophyllea*), lesser nettle (*Urtica urens*), larger mouse-ear (*Cerastium triviale*), curved buttercup (*Ranunculus falcatus*), whitlow-grass (*Erophila verna*),* scarlet pimpernel (*Anagallis arvensis*), stinkweed (*Gilia squarrosa*), field-forgetmenot (*Myosotis arvensis*), winged thistle (*Carduus pycnocephalus*); indigenous—mousetail (*Myosurus* sp., referred in "Manual of the New Zealand Flora" to the Fuegian *M. aristatus*, but not that species), dwarf-forgetmenot (*Myosotis pygmaea*—there are various distinct forms). To the vernal flora may be added the following, since, though perennials, their parts above the ground are present only during part of the year: Introduced—Californian thistle; indigenous—maori-onion (*Chrysobactron Hookeri*), and austral spring-beauty (*Claytonia australasica*—confined to dark faces).

Many of these species of the depleted area were not present in the primitive grassland, while others would be quite rare. Thus a plant-association non-existent in primitive New Zealand has appeared, which, moreover, except during a brief period, is almost useless for supplying food for stock.

If the new flora of the depleted area as a whole be considered the total number of species is about ninety-one, of which fifty-four are indigenous and thirty-seven foreign. In this estimate only the flora of the actual depleted ground is considered; if the flora of wet places, shady spots, and rocks were included the total would be much larger. Even as it is, the flora of depleted Central Otago when compared with that of South Island montane tussock-grassland as a whole—301 species (indigenous 228, foreign 73)—does not appear as small as might be expected. On the other hand, many species come into my estimate which are rare, and some occur in but one or two localities, while a few are confined to saline soil. It is the really common widespread species which count, and such do not exceed forty, while those of the worst-depleted ground occupied by plants hardly number thirty. This fact clearly brings out the difficulties which oppose a solution of the regrassing problem.

THE CAUSES OF DEPLETION.

As at the time of its first occupation by the sheep-farmer there was all over the area that continuous close covering of tussock-grassland which had been there for hundreds of years, the subsequent disappearance of the latter is plainly due to those new conditions to which it was exposed through the operations of sheep-farming. But the treatment to which it was subjected was identical with that of the whole of the tussock-grassland of the South Island since its first occupation; yet, generally speaking, depletion, in the sense of that of Central Otago,

* Not a grass, despite its name, but a member of the cress family.

has not come about. Plainly, then, the sole difference for the pasture here being considered under the methods of pastoral occupation lies in its special climate—the most arid, and, except in winter, the hottest in New Zealand. That the aridity of the climate, above all else, governs depletion is clearly shown by the fact that in the arid area itself as the rainfall gradually increases so does depletion gradually decrease, and that the sunny face of even a quite shallow gully will be fully depleted, when on the opposite darker face there will be more or less tussock. This can readily be observed again and again in proceeding, say, from Cromwell to Lindis Pass. It was, then, sheep-farming, as originally practised—and the methods are not greatly changed since its inauguration some seventy years ago—which first of all laid the foundation of depletion.

In order to render their harsh feed palatable for sheep the tussocks were burnt, not merely in winter or early spring, but at all seasons. Now, in an arid climate or situation a tussock can badly tolerate burning, even during a moist period, and the subsequent eating of the young leaves is highly detrimental to its well-being, while burning during hot dry weather spells certain death. Also, consider the effect of a second burning on tussock not fully recovered from the first attack of fire, and then think of the result of indiscriminate burning year in and year out!

These lower slopes, thickly covered with their primitive, close grassland (but now depleted to the utmost), would appear to offer an inexhaustible supply of feed. There alone could the sheep be wintered, nor could they be sent to the high pastures till well on in the spring; hence, in no few instances, would this grassland be greatly overstocked. So, what with the burning and overstocking, more and more bare ground would gradually appear, the palatable plants would be eaten out, and the tussocks themselves become smaller and weaker.

Then, in the early "eighties" of last century, the rabbit arrived from the lowlands and, as the food-supply decreased, crept higher and higher up the mountains. With an eminently favourable climate, abundant food, and a soil suitable for burrowing, or rocks in plenty for their homes, these animals increased enormously, so that with them and the sheep the country became greatly overstocked. Every plant at all palatable was eaten to the ground; the depleted area ascended higher and higher; those perennials alone could survive which either were not eaten at all or were furnished with far-extending underground stems, and possessed the power of rapid growth after being cropped close. Then there were the annual species, which possessed great and rapid powers of increase by means of seed, or, in the case of such plants as die yearly to the ground, by far-creeping subterranean stems. It is the addition of the three latter categories to the pasture—mostly foreign plants, with sorrel and wild-geranium the most important as feed, whose advent in quantity was made possible by the new bare ground—which has rendered the sheep-runs still productive, bringing in, accidentally—if nature's methods can be so called—far more good feed than the general aspect of the depleted areas would lead one to imagine. Also, it is the composition, distribution, behaviour, and history of this new flora which first of all brings in a ray of hope for the solution of the regrassing problem.

THE PRESENT CONDITIONS FOR PLANT-LIFE.

The conditions offered by the depleted areas for plants are of three kinds—namely, those depending on climate, soil, and grazing-animals respectively. Naturally, they are bound up with one another.

Climate.

The ordinary meteorological statistics regarding climate are to some extent misleading so far as plants are concerned. Each situation has a climate of its own. For instance, the climatic conditions of the following are different: sunny and dark faces; shallow stony soil and deep loamy soil; flat and steep slopes. Also, as Livingston and Shreve state, "The information, so far accumulated, upon environmental conditions has not been obtained primarily with reference to plant activities; it has been brought together mainly in the interests of meteorology, climatology, and weather prediction."* Nevertheless, a brief statement of the condition of affairs, as shown by what may be gleaned from the scanty meteorological data of the upper Clutha basin, shows roughly the climatic obstacles which confront the regrassing problem.

The most arid portion of the area under consideration lies between Alexandra and Lowburn Ferry, where the average yearly rainfall is not more than 14 in., and the average number of days on which rain falls about sixty. Proceeding westwards the rainfall gradually, but slowly, increases, though strong depletion extends to Pembroke. With increase in altitude, too, rainfall also increases, but here other important factors enter in. On the hard bare mountain-slopes most of the rain rapidly runs off the surface, but little penetrating the ground, and a good many hours' heavy rain are required before the soil is wetted to the depth of one inch. Extremely heavy thunderstorms, known locally as "water-spouts" or "cloud-bursts," are not uncommon, but they are usually confined to a very limited area, and the damage they occasion through erosion more than counterbalances their value for plant-life.

The average limit of the winter snow-line really forms the boundary between the winter and summer country; and, if the actual line between the depleted and the grassed areas lies somewhat lower, it also is related to the average length of time that snow may lie. I have no exact statistics on that head, but doubtless at the foregoing limit snow will lie from a few days to a week or two at a time. Its gradual melting does much towards satisfactorily wetting the soil. Mists frequently cloud the upper parts of the mountains, and assist considerably in retarding evaporation.

Notwithstanding the mountain climate being wetter than that of the lowlands, it is dry enough. For the greater part of summer and autumn the beds of mountain-streams are dry, and there is hardly a trickle from the springs. No plant which cannot tolerate a considerable amount of drought can live, and some of the introduced species become so dried up as to hardly seem alive. On the other hand, the common tussocks look much the same at all seasons.

* "The Distribution of Vegetation in the United States, as related to Climatic Conditions," p. 149. Carnegie Institution of Washington, 1921.

The maximum shade temperature usually exceeds 100° F. several times during the summer. Shade temperatures of 80° and upwards are common, while so low as 60° is rare. Even in November the shade temperature may frequently exceed 80°, while for most of the remaining days it may be 70° or more. In September the shade temperature of most of the days may exceed 70°, and 80° is not uncommon for October. In autumn March is a hot month, but during April and May, though there are still many warm days, the climate gradually becomes colder. The sky is usually free from clouds in spring, summer, and autumn, while even in winter cloudless days are common. The heat from the direct rays of the sun is therefore excessive, while low-growing plants are subjected to still more heat from the warm ground.

During winter frosts are frequent; their duration depends, in large measure, upon the lay of the ground. At 1,200 ft. altitude, or often considerably less, dark faces may remain frozen hard for a week or more at a time. But in the full sunshine the ground quickly thaws and becomes soft and muddy, only to be frozen hard after sunset. In the subalpine belt the plants will be protected by a covering of snow, but in the cases just cited they are in the grip of frost for a number of consecutive days, or, day by day, are alternately frozen and thawed. Thus autumn sowing on dark or sunny faces should give different results. The maximum amount of frost up to 1,000 ft. altitude, judging from the presence unharmed of the rather tender insignis pine (*Pinus radiata*) and of several Australian gums (*Eucalyptus*), can hardly exceed 12° F. Nor from observations in other parts of New Zealand, and from the now well-known intolerance for cold above that amount shown by most New Zealand alpine plants, can the winter cold of any of the high mountains greatly exceed that estimate.

The effect of violent winds, especially when in conjunction with intense heat and a dry atmosphere, is a factor of great moment for plant-life. Winds of that character occurring under these conditions are frequent. The most adverse for vegetation are those, frequently both dry and warm, which come as gales from the north-west. When they blow, raising great clouds of dust in the valleys, with the sky cloudless and the rays of the sun burning hot, evaporation reaches its maximum, the plants transpire to the utmost, and, when the dryness of the soil is considered, it can easily be seen that many important pasture-plants would be useless for regrassing operations, since they would rapidly wilt and die. Then, also, there are violent winds from the south-west. These are generally moister in their character, and, though usually they do not bring rain, welcome mists may cloud the higher levels. But these winds, again, may induce strong evaporation.

Soil.

The soil made from the weathering of the mica-schist rocks is extremely fertile, as evidenced by the rich crops on irrigated land, or even the grain crops on ground just outside the area of maximum dryness. On the depleted hills, and even in the valleys, the depth of soil varies greatly. In places rock comes close to the surface, cropping out here and there, or, again, the soil may be many feet in depth. In the valleys also there is deep soil or a thin layer with old river-gravel beneath.

The ground, now that it is bare, is subject to great erosion. A tiny runnel is readily turned into a deep trench after heavy rain. There is no shower but its water descends in rivulets down the slopes, cutting into the soil. In dry weather the north-west gales raise the fine loose surface soil high into the air, and clouds of dust are whirled aloft for hundreds of feet. Small stones are driven along the ground or carried through the air by the furious blasts. This wind erosion is so powerful that Park in his geological account of the district attributes most of the rock-weathering to this cause.

Physical damage to the plants is not greatly to be dreaded in the low-growing members of grassland. Were forest to be established it would be a different matter. But even certain low-growing plants are not immune from attack. Nothing could seem more secure from the wind than the scabweed mats. These, notwithstanding the opprobrious but admirably descriptive name bestowed by the settlers, are not the pest some have supposed, but they are a most beneficial plant on the depleted ground, where they assist to no small degree in combating wind erosion. Unfortunately, the central part is apt to die as the plant increases by peripheral growth, so making a weak spot in the hard surface of the mat or cushion, where the wind and the whirling stones it carries in its path may soon bring about the eradication of the plant (see Fig. 5).

The scabweed, but more especially its allies, supply seed-beds where various seeds, including those of the tussock-grasses, germinate readily. These invading plants, thanks to the humus or the silt within the cushions, grow well, and in time they cause the death of their host. In this way in many parts of the South Island stony river-bed has been converted into grassland.* In the arid area on the hills the scabweed, unfortunately, does little in this regard, but in the sandy valleys many absolutely depleted areas have been regrassed with the poa-tussock (*Poa caespitosa*) in this manner, not one plant having originated on the actual bare ground (see Fig. 6).

A great obstacle towards the incoming of plants on the depleted ground is the general absence of humus as a seed-bed. Frequently the only seed-bed is a smooth surface of soil baked hard by the sun after it had been wet. On dark faces after the late frosts of winter, where the surface is naturally softer, there is formed a seed-bed of fair quality. Cracks in the soil, the slightly moister position near stones and rocks, the shelter of such plants as may be present—all these favour to some degree the germination of seeds.

Grazing-animals.

Some of the difficulties which oppose a solution of the regrassing problem may seem difficult enough to overcome, but these become almost insignificant when the antagonistic action of the hordes of rabbits and the numerous sheep are considered. It is true that the former are kept more or less in check by poisoning and other means, but they are never entirely suppressed, and a bad poisoning or neglect

* See L. COCKAYNE, On the Peopling by Plants of the Subalpine River-bed of the Rakaia (Southern Alps of New Zealand), Trans. Proc. Bot. Soc. Edin., Vol. xxiv, 1911, p. 104. Also C. E. FOWERAKER, The Mat-plants, Cushion-plants, and Allied Forms of the Cass River bed (Eastern Botanical District New Zealand), Trans. N.Z. Inst., Vol. xlix, 1917, p. 19.

FIG. 5. SCABWEED IN PROCESS OF DESTRUCTION BY ACTION OF WIND.
[*Photo by L. Cockayne.*

FIG. 6 SCABWEED, GROWING IN SANDY RIVER VALLEY, SERVING AS SEED-BED FOR POA-TUSSOCK.
Note absence of plants except on the scabweed.
[*Photo by W. D. Reid.*

on the part of the runholder or his neighbour may rapidly undo the work of years. As for stock, the depleted areas, as already explained, are the winter country, and on the ground free from snow, except during brief periods, there cannot be much, even of the least palatable nature, which can escape. Fortunately, in winter, in places there is a good deal of barley-grass, which stock relish, and later on, thanks to the crop of wild-geranium, they remain on the lower country. But this only makes it the worse for other palatable species when the former are eaten out.

CONCLUSION.

The account given in this paper of the conditions which have to be met and overcome before the regrassing problem can be solved is certainly not reassuring. Nearly all the requirements of ordinary pasture-plants appear to be absent, and in their stead stands obstacle after obstacle. Excessive drought, with a parched soil in the presence of high warm winds and a burning sun, has to be met. So, too, germination is to take place on the hard dry ground with perhaps no water for several weeks at a time, and, if the seeds eventually germinate, all is so adverse for the young plants that probably none will survive.

There is denudation resulting from water and from high winds to be encountered. There is no shelter from sun or gales. During the winter the young plants may have to grow for days together on ground frozen all the time, and from which they cannot extract one drop of water, or they may be frozen night after night and exposed to the hot sun day after day.

Finally, even if the plants manage to grow and reach a size large enough for food, they may be exposed to the attack of innumerable rabbits and of such sheep as the pasture can support.

On the other hand, notwithstanding all these difficulties, as has been seen, many plants, some of them of high palatability, have become established by nature on the badly depleted ground, while others linger on year by year ready for growth should the chance arrive. It does not seem unreasonable, then, to conclude that what nature, with but poor materials to hand, should have slowly accomplished, would not be impossible for man equipped with better material to be drawn from many sources, and with a knowledge of nature's methods combined with further knowledge, though yet incomplete enough, of the relation of the plant to soil and climate.

The means taken to learn by experiment certain fundamental matters which may lead some distance, at any rate, towards the desired goal will be told in the second part of this article.

Wheat-sowing after Potato-digger.—In the section of his recent series of articles on "Commerical Potato-growing" dealing with digging (*Journal*, Dec., 1921) Mr. H. E. McGowan, of Willowbridge, mentioned that the tilth left by the machine digger was so thorough that the only preparation required for the next crop was a superficial cultivation. Mr. McGowan now sends some particulars of a crop of wheat grown in his district in the past season on the system referred to. The area was about 20 acres, and received a single stroke of a spring-tined cultivator and a harrowing before the wheat (Victor variety) was drilled in. The crop was threshed the other day, and gave a yield of 66 bushels per acre of a very fine sample. The preceding crop of potatoes had been dug with a Hoover digger.

SHEEP MAGGOT-FLIES.

OBSERVATIONS IN THE PAST SEASON.

DAVID MILLER, F.E.S., Entomologist, Biology Section.

THE sheep maggot-fly investigation undertaken a year or two ago has been carried on throughout the past season, and a great amount of correspondence dealing with the problem has been received, together with specimens, from sheep-farmers in all parts of the Dominion.

It is evident that the golden-haired blow-fly (*Pollenia stygia*) is by far the most active species attacking wool in New Zealand, the next in evidence, but to a much lesser extent, being the European greenbottle (*Lucilia sericata*). In the first account of this work* it was stated that there was some doubt as to the existence in New Zealand of the Australian greenbottle (*Pycnosoma rufifacies*), but during the past season two lots of wool badly infested by spinose maggots (Fig. 1) have come to hand, one from Kaitaia and the other from Bull's. The

AUSTRALIAN GREENBOTTLE (PYCNOSOMA RUFIFACIES).
Fig. 1. Maggot, x 3 (after Froggatt). Fig 2. Fly, x 3.

adult flies in both cases were bred out and proved to be the Australian greenbottle, identification being made certain through the courtesy of Dr. T. Harvey-Johnstone, of Brisbane, and Mr. W. W. Froggatt, Government Entomologist, at Sydney, to whom specimens were sent. That this fly, which is undoubtedly well established in the North Island at least, should now be attacking sheep is a very important feature of the problem, since in Australia its depredations are now more serious than those of the golden-haired blow-fly. In both the above-mentioned cases the larvæ of the Australian fly, *Ophyra analis*, were associated in large numbers with those of *Pycnosoma rufifacies*. Both species also breed in carrion. The spinose maggots of the lesser house-fly (*Fannia canicularis*) and the maggots of the native yellow-horned bluebottle (*Pyrellia antennatis*) were also found in wool infested by the maggots of the golden-haired blow-fly. It is apparent that *O. analis*, *F. canicularis*, and *P. antennatis* are all secondary, and are attracted to wool already infested by the primary parasite *P. rufifacies* or *P. stygia*, as the case may be. The Australian greenbottle (Fig. 2) is readily distinguished from the European greenbottle by its reddish-yellow

* See "Sheep Maggot-flies and their Allies," this *Journal*, June, 1921.

face and the presence of a blackish band across the margin of each abdominal segment.

The main factors influencing the incidence of wool-blowing are climate, food, and shelter, the predominating factor being climate, which has a direct effect not only upon the flies themselves but also upon the food of the sheep. Although the presence of shelter favours wool-blowing it is really of minor importance, since in its absence, if the climatic conditions are favourable, wool-blowing takes place. In localities subjected to severe winters or drought during the summer wool-blowing is usually unknown or of rare occurrence, but under warm and moist conditions not only do the flies increase but the grass is plentiful and succulent, so that the sheep readily become dirty and attract the flies.

Lambs and hoggets are the most subject to infestation, and they are attacked where the wool is dirty, usually around the hind quarters or on the belly. Where a sheep has been lying upon moist droppings the wool becomes stained and may be blown at that spot. In the case of foot-rot the maggots of both the golden-haired blow-fly and the European greenbottle infest the feet, and where the wool becomes soiled during rest by such a decaying foot the blow-flies will attack.

On the whole the mortality from maggot-flies is very low among New Zealand flocks—no doubt due to the practice of crutching at a time when the flies are active—although there are instances of a comparatively high death-rate. Several correspondents estimate the annual loss at 1 per cent., and, if the sheep are left uncrutched, at from 5 per cent. to 10 per cent., while in a great many cases there is no mortality. One observer (Mr. R. J. Barton, of Masterton) who has kept records over a period of several years estimates the mortality among Lincoln hoggets during a wet season at 20 per cent., and among Romneys at 10 per cent.; and during a dry season at 10 per cent. and nil respectively.

INVESTIGATION OF DRY-ROT OF SWEDES.

PREVENTIVE CONTROL BY FARM-MANAGEMENT.

E. BRUCE LEVY, Biological Laboratory, Wellington.

PROGRESS FIELD REPORT.

THE investigation of the dry-rot disease of swedes (*Phoma napobrassicae*), initiated by the Department in Southland some years ago, was continued throughout the season of 1920–21, the work being directed mainly towards an attempt to deal with the dry-rot organism in the soil.* That the dry-rot organism winters over in the soil has now been conclusively demonstrated, and, while a very comprehensive series of soil-sterilization trials was made, the results proved very conclusively the impracticability of control by this means. The trials were conducted on land that had carried two successive swede crops, the latter of which was affected somewhat badly with dry-rot.

* Much assistance in the field-work here reported on has been rendered by Mr. W. Alexander, Fields Instructor for Southland, and by Mr. T. Pattinson, Overseer at Gore Experimental Area. The collaboration of Mr. A. H. Cockayne, Biologist to the Department, is also cordially acknowledged. For previous reports on the investigation see this *Journal* for October, 1919, and November, 1920.

Soil-sterilization Trials.

The scheme of this series was as follows, the quantities stated being per acre in each case, and the material being broadcasted on the ploughed surface in plots 2, 3, 4, 6, 7, 9, 10, 12, and 13: Plot 1, control; plot 2, burnt lime, 2 tons; plot 3, burnt lime, 8 tons; plot 4, burnt lime, 4 tons; plot 5, control; plot 6, sulphur, 3 cwt.; plot 7, sulphur, 9 cwt.; plot 8, control; plot 9, copper sulphate, 3 cwt.; plot 10, copper sulphate, 9 cwt.; plot 11, control; plot 12, iron sulphate, 3 cwt.; plot 13, iron sulphate, 9 cwt.; plot 14, control; plot 15, formalin, 1 pint to 30 square yards; plot 16, carbon bisulphide, 1 pint to 30 square yards; plot 17, control; plot 18, bordeaux mixture 4–6–40, 1 gallon to 2 square yards. In plot 10 the germination was seriously impaired.

On 5th February, 1921 (two months after sowing), this series was carefully examined and the loss in the seedling stage estimated. On 22nd May a further examination was made, and the results of the two inspections are compiled in the following table:—

Number of Plot (sown December, 1920).	Number of Bulbs per Plot (all Plots same Area).	Number of Bulbs dry-rotted in Seedling Stage (5/2/21).	Number of Bulbs dry-rotted (22/5/21).	Number of Plot (sown December, 1920).	Number of Bulbs per Plot (all Plots same Area).	Number of Bulbs dry-rotted in Seedling Stage (5/2/21).	Number of Bulbs dry-rotted (22/5/21).
1	638	11	398	10	216	Nil	56
2	676	10	500	11	700	2	576
3	756	6	506	12	640	3	460
4	724	3	484	13	764	3	356
5	712	5	452	14	740	Nil	302
6	790	3	396	15	724	1	388
7	732	5	480	16	720	Nil	352
8	730	4	456	17	688	2	248
9	436	6	190	18	652	Nil	192

A similar series was repeated on land adjoining on the same experimental area, but this land had not previously been in swedes. Taking the series as a whole, and comparing the corresponding series on the previously non-swede land, it is found that in May the percentages of bulbs affected were as follows: Land previously in swedes, 56 per cent.; land adjoining, but which did not have a swede crop the previous year, 12 per cent. The reason why 12 per cent. of the crop on the previously non-swede land was affected may be largely due to the fact that two years prior to the swede crop this area had carried a crop of soft turnips (Hardy Green Globe) which were slightly affected with dry-rot. The definite patchy nature of the infection on this portion indicated that the centres of spread were more or less few in numbers. These patches were particularly obvious in September, when the final examination of the crop was made (Fig. 1). On the previously swede-crop land there was scarcely a sound bulb, while the remainder of the crop on the non-swede land was still fairly sound, with the exception of the definite patches before mentioned. The severe infection ended abruptly at the junction of the two divisions of land (Fig. 2).

FIG. 1. VIEW SHOWING TYPE OF PATCH-DEVELOPMENT OF DRY-ROT ON SWEDE CROP WHERE CENTRES OF SPREAD ARE WIDELY SPACED.

Practically all the bulbs here shown entirely rotted away were badly affected in May.

FIG. 2. SHOWING IN FOREGROUND ENTIRE LOSS OF CROP ON LAND PREVIOUSLY IN SWEDES.

The crop farther back is on land that did not carry a swede crop the previous year. The junction of the two areas is plainly discernible.

It will be obvious from these results that the dry-rot fungus winters over in the soil, and that wholesale infection of a crop is a result of spread from centres of infection which arise early in the season. Such centres of infection have their origin from dry-rot spores that have wintered over in the soil. The subsequent spread is certainly wind-borne, but the radius of infection from a given centre appears to be quite short, and individual patches rarely exceed 20 ft. in diameter. When the original centres of infection are closer than this the whole crop may entirely rot away (Figs. 3 and 4).

Secondary Wind-borne Infection.

One other point in the investigation was the possibility of reducing as much as possible the secondary wind-borne infection. The growing of bulbs close together, so that a hardier bulb was formed with a denser and longer-lived leaf cover, was tried, but the type of crop produced when thinning-out was not done was not very satisfactory, although a considerably smaller proportion of the bulbs was infected. A second method of ensuring a good leafy protection was tried, which consisted in growing along with the swedes a leaf-producing fodder that was late in maturing. Thousand-headed kale was used, and quite an excellent crop of swedes and kale was produced, the kale lasting well and certainly affording considerable protection to the associated swede-bulbs (Figs. 5 and 6). Such preventive methods, however, are only effective in minimizing secondary wind-borne infection. They are quite useless for preventing the primary or seedling-stage infection, which takes place at an early stage of the crop (February and March), and which certainly arises from spores of dry-rot that are in the soil.

Infection through Seed.

The possibility of infection being brought in on the seed, as in the case of a similar disease, black-leg of cabbage (*Phomo lingam*), has not been disproved, but certainly the number of plants which were killed out in the seedling stage in our tests were considerably in excess on the previously swede land over those on the non-swede land. This indicates clearly that all seedling-stage infection at least is not the result of infected seed. Sixty-four plants killed in the seedling stage were noted over the entire series on previously swede land, but only one or two could be found on the previously non-swede land.

PREVENTIVE CONTROL BY FARM-MANAGEMENT.

From the foregoing it must be accepted as a fact that the initial and the prime source of infection is undoubtedly from dry-rot spores that have wintered over in the soil, and work along lines designed to cope with this source of infection should be carried out. The soil-sterilization trials have proved impracticable, and there seems nothing else but for the farmer to rely on a type of crop-rotation that will, some years before the sowing of the swede crop, eliminate from those areas on which swedes are to be grown any likely factor of soil-contamination.

The main agencies by which soil may be contaminated are—(1) By an infected crop growing on that soil; (2) by stock grazing on an infected

FIG. 3. PLOT I AT GORE AREA IN FEBRUARY, WHERE BULBS THAT HAVE GONE OFF IN THE SEEDLING STAGE ARE INDICATED BY LABELS.

This plot is on land previously in swedes.

FIG. 4. THE SAME PLOT PHOTOGRAPHED IN SEPTEMBER, SHOWING ENTIRE LOSS OF CROP.

Here the centres of infection were close together.

crop and transferring spores of the disease to clean run-off paddocks, either by means of their feet or in their dung; (3) by carting out affected swedes and feeding them to stock in the paddocks; (4) by means of agricultural implements; (5) by agency of wind.

It will be noted that of these various agencies the first four are under the control of the farmer, and without doubt the control of dry-rot must become one of prevention by farm-management rather than one of cure by direct application of remedial measures. A system whereby the swede land may be earmarked some years previously to growing this crop, and the utilization of such area for purposes other than those likely to lead to contamination, would seem imperative. The area on any one farm required each year for swedes is comparatively small, and with careful rotational farming it should be possible to avoid any practice likely to lead to contamination. The difficulty attendant here is the absolute necessity of keeping stock from the prospective swede area during that period of the year when turnips or swedes are being fed.

A Suggested Rotation.

The crops specified below have reference to Southland. In other districts where mangolds can be successfully grown the replacement of swedes with that crop is clearly the method that should be adopted. It will be assumed, as an example, that a swede crop has been grown in 1922 on a particular area. While it is not yet known how long the dry-rot spore will remain viable in the soil, it should be reasonably safe for the swede crop to be repeated after the lapse of six years. For the ensuing years a course of cropping somewhat as follows is suggested, the swedes of the 1921–22 season having been fed off in the usual way :—

First and second year—1922 (spring) to 1924 (autumn): Spring-sow Italian rye-grass and red clover, and feed off by stock until March (or until such time as feeding on turnips or swedes commences). Shut up area and allow it to remain unstocked and cut for hay, or take a rye-grass-seed crop off in December. Graze the aftermath until March. Plough up and fallow for spring.

Third year—1924 (spring) to 1925 (autumn): Spring-sow oats for chaff. Graze stubble until March, then plough.

Fourth year—1925 (spring) to 1926 (autumn): Plant to potatoes, or a portion to potatoes and a portion in winter forages (Thousand-headed kale and chou moellier), which are cut and fed out.

Fifth year—1926 (spring) to 1927 (autumn): Spring-sow linseed, wheat, or barley.

Sixth year—1927 (spring) to 1928 (autumn): Spring-sow oats and tares for hay or ensilage.

Seventh year—1928 (spring): Sow swedes, which are fed off in the usual way.

By adopting some such rotation not only will the swede crop be considerably safeguarded, but provision will be made for summer feed (Italian rye-grass and red clover) and for hay-production (oats and tares), which is so essential a food to balance the winter swede diet. The difficulty of rotational farming, however, is that in order to get the necessary quota of one class of food more land may be required for it than is necessary to provide the necessary quota of another food.

FIG. 5. A ROW OF SWEDES AND THOUSAND-HEADED KALE, WHERE THE KALE IS ACTING AS A GOOD LEAFY COVER AND PROTECTING IN SOME MEASURE THE SWEDE-BULBS FROM SECONDARY DRY-ROT INFECTION.

FIG. 6. THE SAME ROW WITH THE LEAF COVER HELD BACK, SHOWING THE SWEDES PRACTICALLY FREE OF DRY-ROT.

Photographs taken in September. Thousand-headed kale plants marked ×.

[*All photos by E. Bruce Levy.*

Thus more land on a farm may be required for oats than for swedes, or *vice versa*. In the above rotation it will be noted that no stock whatsoever is on the land during the last three years.

The Main Points to observe.

Whether the farmer adopts such a system of cropping as outlined or not, he should at least pay strict attention to the following four main points :—

(1.) Swedes or turnips should not be grown on the same land for two years in succession.

(2.) Stock should not be allowed a run-off from swedes or turnips on to paddocks that may be used for swedes in the next year or so, and any bought-in stock should be kept off such paddocks for a full week. It is recognized that the worn-out pasture is very well broken in again by growing swedes as the first crop, and very often on such pasture-sod quite a good clean crop may be grown. There is, however, always the danger of such paddocks having been recently contaminated by bought-in stock from off dry-rot areas, and the farmer should therefore guard against this source of contamination by regulation of his stock during the turnip season.

(3.) Turnips or swedes should not be fed out on to paddocks which are soon to be broken up for swedes.

(4.) Implements should be well cleaned before leaving a diseased area.

Conclusion.

The control of field-crop diseases by direct remedial measures is often possible, but the margin of profit of certain crops over another crop that may be resistant to disease is usually so small that the cost of control becomes prohibitive, and the farmer is wiser to grow the admittedly inferior crop in preference to the other when costly means of control of disease are necessary. Thus in Southland the yellow-fleshed turnips of the Green-top Yellow Aberdeen type have, even though of inferior quality, largely replaced the swede, and this fact—that the margin of profit between the swede and the yellow-fleshed turnip is small—prohibits the adoption of costly remedial measures, such as spraying, &c., for direct cure of dry-rot of the swede. Consequently a cure, if a cure is to be effected, must be effected by inexpensive means, and farm-management along the lines suggested seems to afford the only promise of success.

Rabbit Districts.—The formation of the Rangitoto Rabbit District in the Wellington Land District, and of the Blackstone Hill Rabbit District in the Otago Land District, has been notified in the *Gazette*.

The Waikato Form of Barberry.—Since the publication of the article on this hedge-plant by Mr. W. H. Taylor, Messrs. Bowler Brothers have received a large number of letters asking that cuttings be sent to the writers. It was clearly stated in the article that any one could have cuttings who would go and get them or send a representative for that purpose, but Messrs. Bowler Brothers have informed us that they do not see their way to prepare and forward supplies.

VINE-CULTURE UNDER GLASS.

(Continued.)

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DESCRIPTIVE TERMS USED.

For a ready understanding of descriptive writing it is necessary to know the meaning of terms used, and the following short explanation should be of assistance in this connection. The developed vine consists of one or more rods. Alternately arranged on either side of a rod are processes termed "spurs"; these are spur-like projections caused by cutting back the side growths. The growths that proceed from the spurs are termed "laterals." During the season of growth side shoots come from the laterals, these being termed "sublaterals." From various parts of the growing lateral, and sometimes from the upper part of the stem of a bunch, there are formed leafless processes with spirally twisted ends; these are the "tendrils." When a young rod is being formed its extremity is termed the "leader." Both laterals and sublaterals are formed on young growing rods as well as on old rods, but in the former case they are, of course, of later growth, appearing as the leader lengthens. At each joint—*i.e.*, where a lateral issues from the main rod—there is a leaf on the rod, and at the base of each leaf there is a bud which will produce its respective lateral the following year. Neither the leaf on the rod nor the bud on the rod will persist after the first time of bearing fruit; both buds and leaves will then be on spurs formed by the shortening of the first bearing-laterals.

TRAINING THE VINES.

Leading Vines into the House.

The vines may have been planted before the house was erected, and if they have been in the ground two years and have made good rods they should be able to produce a few bunches of grapes the first season. If the vines have been planted only one year, then at pruning-time sufficient length of rod should be left to reach into the house—that is, supposing the house has been erected so as to leave the vines outside. In such cases, whether it is intended to work up one rod or two rods to each vine, only one rod should be taken in. If, however, the house is built over the vines two rods may be left if desired, provided they have been secured in the right position. In either case the one-year-planted outside vines will require the same training as those newly planted inside the house. Those having a year's start should, however, make more growth than those newly planted.

In the case of vines planted outside after the house has been erected a strong growth should be selected for leading into the house. This should in the first place be secured to a strong stake inserted in the ground at an angle, so that it will be led to the aperture left for its admittance to the house. As soon as the point of the young rod reaches the aperture it should be led in and, when sufficient

growth is made, tied to a stake leading to the bottom wire. If the vine is to have only a single rod it should, on the young rod reaching the wire, be led straight up the roof; but if the vine is to have two rods the tip should be pinched off so that the two laterals nearest the top will form the rods, these being trained along the bottom wire for the correct distance and then led up as in the case of the single rod.

Some growers attach to the wire a lath of wood for tying the young rod to, thus ensuring that the vine will be kept straight. In other cases, where the wires are stretched up the roof instead of horizontally along it, each rod is tied to a wire, which answers the same purpose. Neither of these plans are really necessary, however, and it is quite easy to keep the rod straight by tying it to horizontal wires, using the rafters as guides towards this end. In the case of an established vine having a single rod long enough to reach into the house, either one or two rods can be worked up direct from the top or the two top buds, as the case may require.

Establishing Strong Plants.

The firm establishment of the vines is the first care of the grower. This is secured by inducing the vines to make a vigorous top growth, which in turn causes the formation of a proportionate amount of root-growth. When borders are well filled with healthy roots good top growth in after-years can usually be counted on. In former times it was customary, after the first season of growth, to cut the young vine back to within a bud or two of its base; but this plan has now been generally abandoned, and with a view to bringing the vine into earlier bearing a length of 3 ft. to 4 ft. of the young rod is left. In carrying out the former plan the growth made during the first season was allowed to go almost unchecked, with merely a pinching of laterals here and there to prevent overcrowding. This will not answer in modern practice.

It is necessary to deal with growth in a systematic manner, for it is the nature of a vine to make its strongest growth at the top. The farther the vine reaches the greater is the strength of the top growth as compared with growth on the lower part of the rod. In fact, the top growth robs the bottom growth of sap. When a certain length of the young rod is to be left some restriction of growth is necessary, or the lower buds will be left very weak. It is well known that the lower spurs often produce very poor bunches, while the best bunches are usually borne on the upper half of an established rod; the natural tendency is always in this direction. The difference is most marked when a rod has been forced up too quickly, and is further accentuated by neglect to control growth during the active period of the first season.

First Year's Training.

When the young vines were cut back at least two buds should have been left for each rod wanted. If the vine is to be trained to a single rod two buds are sufficient, but double that number will be required if two rods are to be worked up. The reason for this is that there are many things that could cause the loss of a young shoot, so an extra bud should be kept in case this happens.

When sufficient growth has been made to enable it to be done the leaders required should be loosely tied to the stakes previously mentioned, and when these leaders are safe the spare shoots can be rubbed off or pinched back. When the leaders reach the first wire they should be tied to it, tying being loose to allow for the swelling of the rod. They should, in fact, be slung rather than tied under the trellis. Some incautious people train the rods over the trellis, but this is a very great mistake. When the rods are below the trellis they can be taken down for pruning and cleaning; if they are above the trellis these operations are rendered difficult, and cannot be properly performed. When the rods are underneath it is also much easier to tie the laterals to the trellis, as these always grow up towards the glass, while if their base is above the trellis it is sometimes a difficult matter to bring them down. It is a good plan, with very strong growers, to sling the rods on hooks a few inches below the trellis. This greatly facilitates the tying of the laterals.

It has been already stated that the vine makes its strongest growth at the top. This occurs not because of the height, but because this portion is the extremity of growth. Precisely the same thing occurs however many rods a vine may have, the ends of the rods inclining to make stronger growth than any other part. Any one of the laterals from a rod, whatever its position may be, would, if left unchecked, make growth as strong as the leaders, thus proving that the vine is as strong naturally in one part as in another. Unchecked growth draws sap to itself, and to some extent weakens other parts. This principle must be kept in mind, as it is a guide in the necessary control of the young growths.

If a vine in its first year were allowed to grow without check the lateral growths would develop almost as strongly as the leader, and this would result in a very poor growth of rod. It is therefore necessary to check the lateral growths for the purpose of strengthening the rod. The laterals must not, however, be entirely suppressed, as doing so would cause the buds on the leader to break, and these are wanted for the next season. Although the laterals must be left they must not be allowed to extend far, otherwise they would draw too much sap from the rod, and the buds on the main rod at the base of each lateral would not be properly developed. In addition to this evil there would be crowding of foliage, which must be avoided: all large leaves must have room to develop so that their surfaces may be exposed to the light. A few good leaves are of greater benefit to the vine than any number of smaller and crowded leaves.

When the young vine gets fairly into growth it advances rapidly. The leader should be loosely tied as becomes necessary. Care in handling is necessary or the leader may be broken. The tips of the laterals should be pinched off when they have made three or four leaves; sublaterals when they have made one leaf. The points of the laterals will break again. These breaks should be pinched after making one leaf, and all future breaks from the laterals and sublaterals should be similarly treated. This plan of stopping is to be continued for 6 ft. or 7 ft. of the rod's length, and at this height the top of the leader should be pinched off. This will cause a temporary check in extension and will strengthen the lower part. A new leader will soon start; it should be allowed to extend at will, nor should the laterals it

makes be pinched. The growth may extend so as to fill all space, but should not become a tangled mass; enough should be removed to prevent this, as tangled-up leaves cannot fully perform their functions. Young vines that do well are able to fill a fair-sized house with growth, and the treatment here advised is based on the assumption that they will do so.

By the end of February the portions of the rods on which the laterals have been checked should have assumed a brown colour, a sign of ripening or maturity. Early in March the laterals on these portions should be cut back to their base. This will leave no lateral growth, but at each joint there should be a good leaf on the main rod. Each leaf influences the bud at its base—plumping it up and bringing it to maturity. If any of these leaves have been accidentally lost the lateral at that point should not be entirely removed, but should be shortened to one leaf.

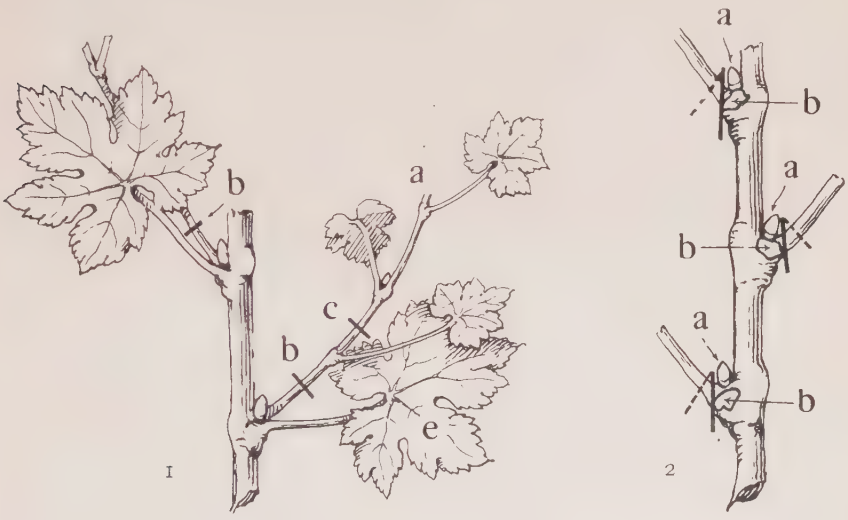


FIG. 1. YOUNG GROWING ROD.

(*a*) Where the laterals are first pinched; (*b*) where the lateral is to be cut back to in March; (*c*) where lateral should be cut in March if the large leaf at its base has been lost.

FIG. 2. WINTER PRUNING FOR A YOUNG ROD.

(*a*) The buds to form future bearing-laterals; (*b*) the wrong way to prune—the dotted line shows the right way.

During the month of May the vinery should be ventilated as freely as possible. Any growth made at this time is of no value; it may, in fact, be rather detrimental. The chief object now is to get the canes well ripened. The leaves should fall in June, and pruning should be at once attended to. Leaves may be holding on late laterals after all others have fallen, but pruning should not be delayed for these, as they are of no consequence. Late pruning causes the vines to bleed, and if bleeding is excessive it seriously weakens the vines. The length of rod to be left depends on its strength. It may

be as thick as one's thumb, and, if so, 5 ft. may be left; if as thick as the forefinger 4 ft. may remain; while 3 ft. is ample for weaker rods. The stronger rods may be allowed to carry a light crop the next season—say, a bunch to every other lateral. It may be noted that in former times these vines would have been cut back again to the plate or to the bottom wire.

MANURING.

It is a common custom to utilize the vinehouse for tomato-growing until the vines are well advanced. In such cases, if the vines are planted inside the house, they will get their share of the fertilizers and water used for this crop, and no special feeding is necessary. If the vines make good growth the roots will soon reach the outside border. If planted outside, then as soon as growth has fairly started a light mulch of manure should be applied. The mulch should not be given at too early a period of growth, however, as the warmth of the sun is required to start the vines, and mulching would shut this out. By the time the vines are in good growth the days will be longer and sun-heat greater, causing the surface soil to dry quickly and the vine-roots to go down in search of moisture. It is of great importance to prevent this. The roots should be kept as near the surface as possible, for if what may be termed the foundation roots are deep down, future roots will go deeper still unless drastic steps be taken to attract them to the top soil. If the roots are deep down not only do they lose the benefit of the good soil in the border, but they are also likely to get into cold, sour soil, resulting in several evils, which will be dealt with later on. A mulch serves to retain moisture in the top soil so that the roots are encouraged to work in it.

It may be well to cite a personal experience of the effect of a mulch. This was a case where vines had been planted two years and had made good growth. On examining the border no roots could be found in the top spit; they had gone straight down. The border was fully exposed to the sun and situated on a hillside. Water could not lie in the subsoil, which was of pure clay. When the vines had got a good start, and before dry weather set in, a mulch of about 10 in. of fermenting stable manure was given. By the end of the season what was left of the manure was mostly a black mould. Roots had come up and even entered the manure, while the border itself was matted with roots, and could only be loosened lightly with a fork. During eight further years this border could not be dug, it being possible merely to loosen the surface to take out weeds. Each year a light mulch was given and some fresh loam added to the border.

The mulch on the border does not supply moisture—it merely enables the surface soil to hold it; watering may therefore be required at times. Liquid manure should not be given to a young vine, which, having a new border to work in, will find all it requires.

VENTILATION.

Where tomatoes are grown inside, treatment will, of course, be adapted to that crop, but the requirements of the two plants are in some respects different. Tomato-houses are generally, and quite rightly, kept as dry as they can be; grapes like more moisture. This

is a reason why tomato-growing should be discontinued as soon as the vines are able to produce a fair crop. The young vines should be well syringed at closing-time, or they may become a prey to red spider. Where the vines have the house to themselves the top ventilators should be opened early in the morning so as to secure a movement in the atmosphere to carry off moisture that has condensed during the night. The bottom ventilators should not be opened until the moisture on the leaves has been dispersed, or an attack of mildew may be caused. When the night moisture has disappeared the floor may be damped down so as to create what is termed a buoyant atmosphere, a condition the vine flourishes in.

It may seem strange to advise getting rid of the night moisture because of the fear of mildew, and then damping down. The explanation is that condensed moisture on the leaves is in the form of globules of water. If the sun shines strongly on the house before this water is dispersed very rapid evaporation is caused. This lowers to nearly freezing-point the temperature of the spot on which the globules of water are seated, and mildew ensues. Rapid evaporation is also caused by the admission of a current of air, with the same result: this is why the bottom ventilators should not be opened while the leaves are wet. The effect of wind on moisture situated on a body is easily understood by the experience of bathers. One may come from water that is much colder than the atmosphere, yet shiver with cold. This is because the wind, together with the heat of the body, causes rapid evaporation, and consequently a very much lowered temperature on the skin. Exactly the same phenomenon occurs on vine-leaves. On the other hand, water thrown on a floor rises as vapour and tempers the atmosphere, but does not settle on the leaves.

The house should be closed up before the sun has quite ceased to shine on the roof, and the vines well syringed. This must be done in a thorough manner so that the rods get their share as well as the leaves. A thorough syringing in the evening and prevention of an arid atmosphere during the day are usually sufficient to prevent attacks of red spider and thrip. After the evening syringing the vines and house will be wet, but this state should not last long. If the house has been closed while the sun is still on the roof the temperature will have risen a few degrees, and this extra warmth will cause a good deal of the moisture to be dispelled as vapour. On dull or rainy days no damping-down or syringing should be done, as the atmosphere will be damp enough without it.

(To be continued.)

Noxious Weeds.—Hawthorn and lantana have been declared under the Noxious Weeds Act by the Greytown Borough Council.

New-Zealand-grown Turnip-seed.—During last season a quantity of New-Zealand-grown turnip-seed was distributed by the Department to reliable growers in Canterbury for experimental purposes. In all cases the seed showed superiority over imported seed in regard to germination and vigour of the young plants. This seed can be profitably produced at a lower cost than the price of imported seed.

FIREBLIGHT.

INCIDENCE OF THE DISEASE IN NEW ZEALAND.

R. WATERS, Biological Laboratory, Wellington.

One hundred and twenty-eight years ago (1794) a record appeared for the first time of the occurrence of fireblight in New York State, U.S.A., and more than a century has now gone by since the announcement of its prevalence in North America. Bacteria were certainly known at that time (1817), though there was no good reason to believe that they were responsible for fireblight or any other plant-disease. Suggestions had been made that they might be causative of animal-diseases, but little attention was paid to this matter until 1849, when Pollander and Davaine associated bacteria with the condition of anthrax. Twenty-seven years later (1876) R. Koch clearly demonstrated that anthrax in animals was due to a specific bacterium. Then comes the first record of the association of bacteria with plant-diseases, Burrill (1877) noting them in fireblighted pear-twigs. Thus the Americans have known the fireblight condition for over a century, while for forty years they have recognized it as a bacterial disease—and still it spreads. In 1909 the disease was reported as more widely spread in Canada than ever it had been before; it was "continually spreading into new territory, causing heavier losses than formerly to the fruitgrowers." In certain States of the American Union it has rapidly wiped out the pear-orchards over extensive areas. In 1911 it was recorded as very destructive in northern parts of Japan.

The announcement of the presence of fireblight in New Zealand in 1910 caused some sensation, and now the disease is seriously regarded by most growers and associations throughout the Dominion. *Bacillus amylovorus* (Burr) Trev., the bacterium responsible for the fireblight condition, was isolated by the writer first in 1919 from pear-twigs grown at Te Papa, near Auckland City. Soon afterwards it was isolated out of hawthorn from the Waikato. The inoculation of a pure culture of this bacillus into pear proved conclusively that the organism from hawthorn was capable of instituting the fireblight condition in pear (Fig. 1). Tauranga and Opotiki, in the Bay of Plenty, were the next new districts shown to be infected. In the early part of 1920 fireblighted fruit-tree specimens were received from widely separated points throughout the Auckland Province, and by the end of that year the disease was known to extend from Warkworth in the north, down through the Auckland Province boundaries to the Waikato district about fifteen miles to the south of Te Awamutu, and across the Te Aroha Mountains to the neighbourhood of the Bay of Plenty. In 1921 the disease extended considerably within these limits, manifesting itself at certain points in a virulent form. In 1922 Taranaki was invaded, and, finally, a single specimen of the disease has recently been detected in the Wanganui.

METHODS OF INFECTION.

Many interested persons in the Auckland and other provinces have been on the lookout for fireblight, and consequently thousands of specimens have been forwarded through various local departmental

officers to the Biological Laboratory, Wellington. Only a small proportion of these specimens was found to be infected with fireblight, but the practice of submitting all doubtful material for examination was, for obvious reasons, freely encouraged.

In New Zealand fireblight has been found on pear, hawthorn, apple, and quince. Furthermore, it has definitely been proved capable of serious injury to the medlar—a host, I believe, that has not previously been recorded in any part of the world. Pure cultures of the medlar organism when inoculated into pears rapidly set up the fireblight condition. In this country fireblight has not yet been found on any of the stone-fruits—peach, apricot, cherry, and plum—nor on

FIG. 1. ON RIGHT, A PEAR-TWIG OOZING AND DYING AS RESULT OF INOCULATION WITH A PURE CULTURE OF BACILLUS AMYLOVORUS TAKEN FROM HAWTHORN. ON LEFT, AN UNINFECTED CONTROL SHOOT SHOWING NO SIGNS OF DISEASE.

mountain-ash (genus *Sorbus*), juneberry (genus *Amelanchier*), or japonica (genus *Pyrus*), although on very rare occasions it has been found on all of these in North America.

Here, as in America, pears have suffered most; the control of the disease in them is certainly more difficult than in apples. No apple varieties have yet been proved to be immune to the disease, but some varieties are somewhat more resistant than others. Our primary difficulty in combating the disease in the apple is due not so much to the character of the disease in this species, but rather to the liability to reinfection from diseased hawthorn, a factor scarcely met with in North America. Hawthorn is not only abundant in parts of the Auckland Province, but it also takes the disease fairly freely. Thus the abundance of fireblight hosts in any locality is a means for rapid spread and a hindrance to satisfactory control. On the other hand, the scarcity or absence of fireblight hosts facilitates control, or even may constitute a natural barrier to the spread of fireblight. As to the importance of

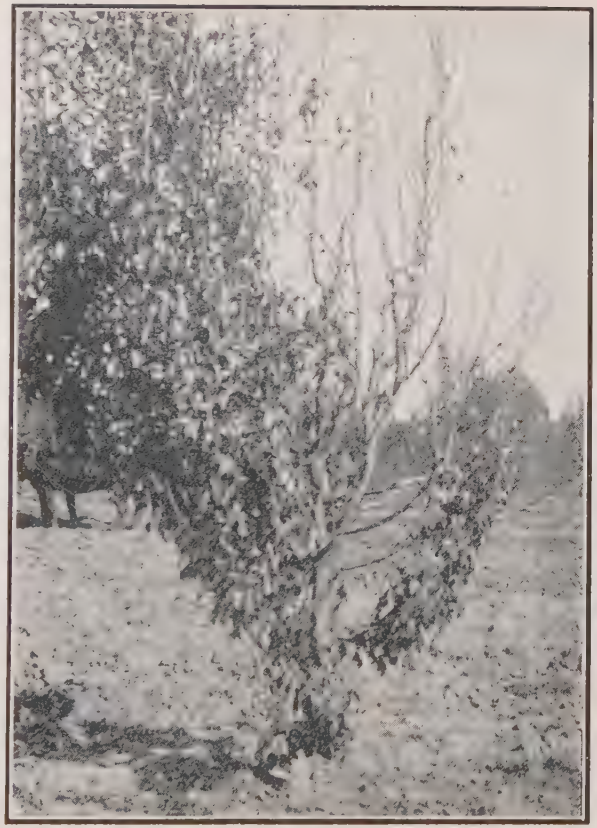


FIG. 2. (LEFT) PEAR-TREE WITH ONE BRANCH GIRDLED BY FIREBLIGHT, THIS ACCOUNTING FOR THE DEATH OF THE LEAVES ON THE LEADERS AND TWIGS ABOVE.

FIG. 3. (RIGHT) CUT SURFACE OF APPLE-TWIG, SHOWING, AT THE POINT MARKED ×, A QUANTITY OF SHINING LIQUID OOZE.

the remaining host plants, it may be said that their relatively smaller numbers minimize their importance so far as orchard-control measures are concerned. In America quince and juneberry appear liable to serious injury, but the stone-fruits are reported to be rarely affected there.

While, therefore, the pear is our most seriously affected fruit-tree, the orchard industry is more concerned with the effects upon the apple. Owing, however, to the enormous extent of hawthorn hedges in certain of our fruitgrowing districts the control of fireblight in either apples or pears is inseparably connected with the eradication of hawthorn.

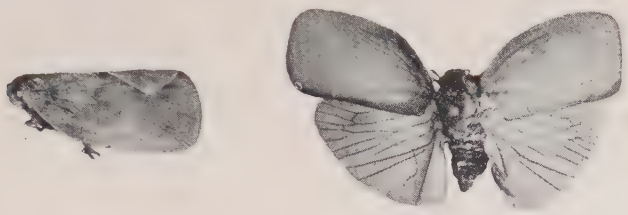


FIG. 4. THE FIREBLIGHT PLANT-HOPPER (SEPHENA CINEREA KIRKALDY), WITH (*a*) CLOSED AND (*b*) EXTENDED WINGS.

NATURE OF THE DISEASE.

After the fall of the leaves and throughout winter one might easily underestimate the extent of damage in a fireblight-infected orchard. The lower temperature at this time checks the development of the disease, and such injury as is present is not so clearly seen on the leafless trees. As the foliage develops in the spring and the bacteria increase in activity their presence in the bark below is quickly indicated by the death of the leaves above. The death of the leaves on a twig, leader, branch, or trunk is often the first effect that arrests the attention of the orchardist; the causative bark-injury may be subsequently traced. The bark of such twig or limb is not necessarily damaged throughout its entire length. Frequently it is merely girdled by the disease at one place; this is sufficient to limit the food-supply to the leaves above, which consequently die (Fig. 2). An examination of damaged bark will show that it is discoloured from a reddish-brown to black. Under the microscope these areas are frequently found crowded with countless bacteria. A single bacterium may produce millions of its kind in the course of a day, and frequently we find that their rapid multiplication and increased bulk have set up pressure beneath the bark. As a result of this pressure the affected area may be extended; it may cause the formation of bark-blisters, exuding a turbid sticky fluid when punctured, or it may press out such fluid through ruptures or through the breathing-pores (lenticels) in the bark (Fig. 3).

This is a most important phase in the life-cycle of the organism, for at this stage the spread of the disease is effected. The exudate or ooze is fluid at first; later it may dry to a stiff gum-like mass of an amber colour, or it may harden off in dry weather to a smooth

FIG. 5. BLOSSOM-INFECTION ON APPLE, FOLLOWED BY KILLING OF FRUIT-SPUR AND TWIG.

FIG. 6. TWIG-INFECTION ON PEAR, THE DEATH OF THE LEAVES SHOWING THE EXTENT TO WHICH THE DISEASE HAS TRAVERSED THE STEM.

reddish solid that quickly softens and reliquefies with moisture. This ooze is a living mass of bacteria in a sticky matrix. The writer has shown that such bacteria are capable of living in dried exudate for a period of nine months. He has likewise shown that the organism was alive and capable of setting up infection after immersion in distilled water for two months. The production of ooze regularly synchronizes with the flowering-period of all the important apple and pear varieties. Ooze has a peculiar attraction for insects, which are consequently largely responsible for its transference from the bark to the blossoms. Rain, too, may aid the spread in an affected tree. Once the blossoms are infected the organism can reproduce itself in the nectar, and the further spread of infection is accelerated by the main body of the pollinating insects.

Fireblight was the first bacterial plant-disease shown to be transmitted by insects, and the patient work of many investigators has resulted in a most formidable list of insects concerned in this matter. Many of such insects are present in New Zealand. In March, 1921, Dr. R. J. Tillyard, of the Cawthron Institute, Nelson, collected a small slate-grey plant-hopper (*Sephena cinerea* Kirkaldy*) which he found abundant in the infected part of the Waikato district. These he handed to the writer, with the result that *Bacillus amylovorus* was isolated from the mouth-parts. The inoculation of this organism into pear-shoots showed that it was vigorous and capable of instituting the disease. This adds another to the already long list. Bees, aphides, borers, and other kinds of insects have all been shown to carry infection (Fig. 4).

Our field experiments have shown that the effects of blossom-inoculation may not immediately become apparent, but scarcely have the young fruits commenced to form when such effects are manifested in the blackening of the calyx-cup or of the parts immediately beneath. Initial infection takes place so very commonly at the blossoms that in certain parts the disease is generally known as "blossom-blight" (Fig. 5). In the presence of suitable conditions of moisture and temperature the blackening process extends from the immature fruit down through the fruit-stalk to the spurs or twigs. Twig-infection may result from other causes than blossom-infection. Any soft young growths—twigs, suckers, or the like—are liable to infection through the punctures of "sucking" or "biting" insects. The death of fruit and other twigs is so characteristic of the disease that it has come to be known in parts of America as "twig-blight" (Fig. 6). The disease, however, may not stop at the twigs. In pears it often advances into the branches, on to the leaders, or even to the trunks. Such rapid progress is, fortunately, not met with in apples. The disease passes through the tougher bark of old apple-trees more slowly than through that of young trees. In like manner the disease will pass more rapidly through young bark than it will through the older bark of a tree. In pears it has been known to reach the main trunk, killing large trees outright in a single season.

* Mr. J. G. Myers, F.E.S., of this Laboratory, is publishing an account of the life-history of *Sephena cinerea*.

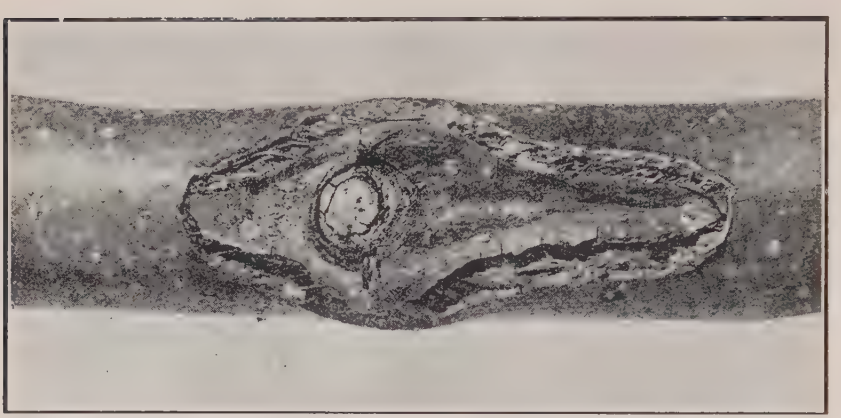


FIG. 7. FIREBLIGHT CANKER.

The canker is bordered by a crack, which commonly occurs at the junction of the healthy and diseased tissue. In the centre of the canker is the stump of the twig down which the disease progressed.

FIG. 8. ANOTHER FIREBLIGHT CANKER.

The irregularly cracked bark on the branch above the white band shows the position of the cankered bark.

The disease has now been briefly traced throughout a single season, and by the end of that season we have reached the same points from which we started—namely, the infected bark of the twigs, leaders, branches, or trunks. By this time, then, the colder weather of autumn will be arresting the activities of the bacteria. The disease may have progressed no farther than the twig, which dies as a result. The attack, however, may have been carried just beyond the base of such twig into the supporting limb. The result is that this small affected patch in the limb surrounding the twig-base commences to dry; it cracks at its junction with the unaffected tissue, forming a roughly circular dry depression known as a canker (Fig. 7). Cankers of greater extent but less definite shape are similarly formed when the disease has managed to advance farther still before being deterred by environmental conditions (Fig. 8).

This brings one to another phase of the disease of outstanding importance—the hold-over canker. The bacteria, as already seen, are able to survive the winter in the bark of fruit-trees; it is in or near cankers such as these that they are located during that time. Not all cankers thus formed exude ooze in the spring; it would appear that in some the organism dies out. It is now clear that if the disease is thus carried over from season to season in cankers, then the excision or destruction of such cankers must constitute a fundamental method of treatment. The cutting-out of fruit-tree cankers is assiduously practised at great cost but with excellent results in the United States and elsewhere. It is, however, an immensely larger matter where in addition to this laborious process the cankers of hundreds of miles of hawthorn hedges have to be considered. This is what we in New Zealand have to reckon with. On the outbreak of fireblight in New Zealand it became immediately of the utmost importance to know whether fireblight could be carried over in hawthorn-cankers. Cable communication with Washington drew from the American authorities no definite information on this point. Close observations have since been made month by month, and cultures and inoculation tests at intervals. The verdict is that fireblight can survive the North Island winters in hawthorn-cankers. This cankerous stage of fireblight has led to the use of the name "blight-canker," and the survival of the organism in cankers accounts for the common use of the term "hold-over canker."

(To be continued.)

Purebred Dairy Bulls.—As showing the steady increase in the use of purebred bulls in dairy herds, one of the Dairy Division's testing officers reports that in his district within the past two years no fewer than sixty herds have been headed with purebred butterfat-record sires in place of grade bulls. In addition a number of purebred females have been introduced into the same district for foundation breeding purposes.

The Gall Chalcid of Blue-gum: A Correction.—In the account of this insect published in the November, 1921, issue of the *Journal* it was inadvertently stated that Dr. L. O. Howard, Chief of the United States Bureau of Entomology, had identified and was describing the insect. In a letter just received from Dr. Howard the writer's attention is drawn to this mistake, and it is pointed out that the work of identification and recording was carried out by Mr. A. B. Gahan, of the Bureau, as stated in Dr. Howard's original letter.—*David Miller, Entomologist.*

CROSSBRED SHEEP AND WOOL IN NEW ZEALAND.

J. G. COOK, Wool Instructor, Live-stock Division.

THE term "crossbred" is used in New Zealand to describe certain lines of sheep, and the wool grown on such sheep. The term is thus used because it is found convenient for making a distinction between this and other crosses. This was pointed out in the writer's article on the half-bred sheep and its wool, published in the *Journal* for May, 1921.

In New Zealand we have five of the British white-faced or long-woolled breeds—namely, Lincoln, English Leicester, Wensleydale, Border Leicester, and Romney Marsh. The Wensleydale is a recent importation; the other four breeds are well known.

Taking any two of the longwool breeds and mating them with each other, the progeny in all cases is a crossbred. Then taking the ewe progeny of this crossing and mating it with any longwool ram, the progeny is also a crossbred; or taking the ewe progeny of each succeeding generation and mating it each time with any longwool ram, the progeny is again crossbred. Succeeding generations will remain so unless the ewes of each generation are mated with the same breed of ram as used in the first crossing, which would result in time in the other strain being bred out.

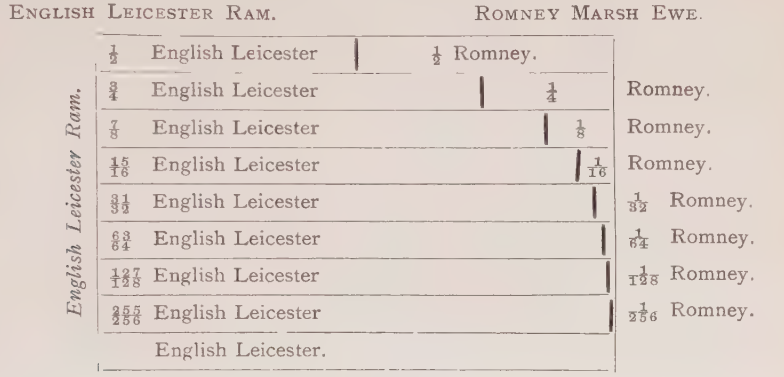
Then there is the progeny produced by crossing or mating any rams of the above-mentioned longwool breeds with the Shropshire ewe, or mating a Shropshire ram with any longwool ewe. In each case the progeny is a crossbred sheep, and likewise remains crossbred unless bred back to one breed until one strain is bred right out.

It does not matter how many lines are produced, so long as the two strains are apparent the sheep is a crossbred.

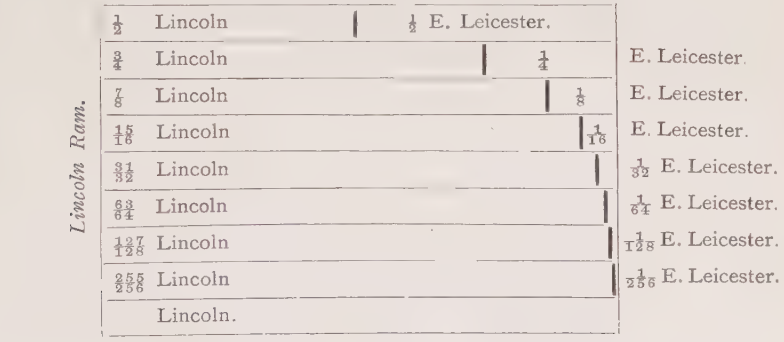
There is a wide range in the spinning-quality of crossbred wool, which runs from 38 up to 48 counts. The lower-spinning-quality wool is grown by the sheep which has been produced by breeding back to the Lincoln breed. The first cross by the Lincoln ram out of the English Leicester, or *vice versa*, would produce 38's quality. The Lincoln-Romney cross and the Lincoln-Border Leicester cross would grow wool of about 40's. If the cross was that of a Romney or Border Leicester ram out of a Lincoln ewe, the spinning-quality would be slightly higher—42's. With the cross produced by a Romney ram out of an English Leicester ewe, or of a Border Leicester ram out of an English Leicester ewe, the spinning-quality is higher again—up to 44's. There is very little difference between the wool grown by sheep produced by the Border Leicester and Romney cross, or *vice versa*, as both these breeds will on the average give 44's to 46's, and in some few instances 48's. The quality of the wool grown by sheep produced by the longwool breeds out of Shropshire ewes or by Shropshire rams out of longwool ewes varies in proportion to the breed of the longwool ram used in the first case, and the breed of longwool ewes used in the latter case. It will be from 42's to 48's.

It does not matter how many lines are produced, so long as there are the strains of two breeds in the wool it must be classed as a crossbred wool. In all cases it is a long, shafty, strong combing wool, and in several lines gives a high percentage of clean yield. Buyers allude to crossbred wool in three terms—namely, 38's to 40's, coarse crossbred; 42's to 44's, medium crossbred; and 46's to 48's, fine crossbred.

The following diagram will serve to show the lines of progeny produced by mating the English Leicester ram with the Romney Marsh ewe, and then mating the ewe progeny of each succeeding generation with an English Leicester ram until the Romney strain is bred out. As long as the Romney strain is apparent the sheep is a crossbred.



Similarly, the next diagram shows the lines of progeny produced by mating the Lincoln ram with the English Leicester ewe, and then mating the ewe progeny of each succeeding generation with the Lincoln until the English Leicester strain is bred out. As long as the English Leicester strain is apparent the sheep is a crossbred.



Seaweed for Manure.—Seaweed makes a very similar manure to farmyard manure, except that it contains less phosphates. It should be used in the same way—preferably ploughed in before a root or forage crop.

WEEDS AND THEIR IDENTIFICATION.

(Continued.)

CAPE HONEY-FLOWER (*MELIANTHUS MAJOR* L.).

ESMOND H. ATKINSON, Biological Laboratory, Wellington.

THE subject of this article, long known as a garden-escape in the warmer parts of New Zealand, has of late years begun to show signs of aggressiveness in the North, and has recently been added to the Third Schedule of the Noxious Weeds Act. Although Cape honey-flower is really very different in appearance from all other plants, indigenous or introduced, in New Zealand, there seems to be a good deal of uncertainty as to its name and relationships. It appears desirable, therefore, in view of its official recognition as a weed, to include in this series a sufficient account of the plant to clear up whatever confusion may exist regarding it.

DESCRIPTION.

Cape honey-flower, botanically speaking, is a shrubby plant, though its great lush leaves, almost concealing the soft-looking stems, give it an appearance as different as possible from that of most shrubs. On pushing aside the rank leaves, however, there will be seen a mass of bare stems an inch or so in thickness, which are decidedly woody below, though brittle and filled with pith. It is only the upper part of these stems that is upright, their horizontal bases forming quite an intricate tangle on or beneath the surface of the ground, and rooting freely wherever they touch it. This semi-prostrate and rooting habit enables the plant to spread rapidly and form large patches.

The upper parts of the stems, where alone the leaves are borne, are herbaceous in character, and are either quite hollow or more or less filled with pith. The leaves are compound and of the type known as pinnate, of which examples may be seen, though on a far smaller scale, in such well-known plants as the rose, "biddybiddy," and kowhai. The leaves of Cape honey-flower are very large, being sometimes 2 ft. long by 1 ft. wide, though they are often smaller. The leaflets are arranged in from four to eight opposite pairs, with an odd terminal leaflet, the lowest pair being usually somewhat smaller than the others. All are sharply and coarsely toothed, and their bases are connected by a wing which runs along the main axis of the leaf, and in the upper part is toothed like the leaflets. In colour the leaves are a curious bluish-green, which is very striking when seen in the mass; the under-surface is decidedly paler. A noticeable feature is the presence at the junction of the leaf-stalk and stem of an outgrowth which encircles the stem, and is joined to and covers the base of the leaf-stalk, tapering above to a fine point. We know by analogy that this has arisen by the fusion of two similar outgrowths known as stipules, which are very conspicuous on some plants (the clovers being good examples) though absent on many others.

The flowers are borne in long curved racemes (an arrangement similar to that found in the foxglove), each flower springing from the

base of a tapering bract. The stalk, bracts, and flowers, though more or less variegated with green, are in the main of a dark-brownish or purplish-red colour. Their colour and the height at which they are carried above the foliage-level make the flowers very conspicuous. They certainly add to what most people would call the "tropical-looking" appearance of the plant. The individual flowers are of so peculiar a shape as almost to defy description in non-technical language. A short account of their parts, however, together with the section of a flower shown on Figure 2), should make their structure obvious. The end of the slender stalk bearing the flower is irregularly expanded into a kind of disk round which are inserted the sepals and petals. The lower and larger part of this disk is produced into a hollow pouch or spur, which is filled, often to overflowing, with nectar having a rather

FIG. 1. A GROWTH OF CAPE HONEY-FLOWER.
[*Photo by W. D. Reid.*

unpleasant smell. There are five sepals, the lowest (which is much the smallest) being arched over the open end of the spur, protecting its contents from rain and preventing birds and insects from reaching them from the front of the flower, which would thus be robbed of its nectar without securing pollination in return. There is a further protection to this honey-well in the shape of a kind of wall of tissue which grows up from its edge. The other four sepals, which are more than twice as long as the one just described, spring from near the expanded top of the flower-stalk, and form a long boat-shaped hood over the stamens, which are four in number, one pair being longer than the other. The petals, which form the showy part of most flowers, are in this case very inconspicuous, being small and tongue-shaped, and projecting but

slightly from the mouth of the flower. The ovary, which is four-celled with several ovules in each cell, is crowned with a curved style, intermediate in length between the long and short pairs of stamens.

The abundant honey, which falls in showers when the flower-spikes are shaken, attracts birds, which are probably the chief pollinating agents. In New Zealand the silver-eye (*Zosterops*) and other small birds have been seen at the flowers, and bees doubtless visit them also. After fertilization the ovules develop into shining black seeds about $\frac{1}{6}$ in. in diameter, the ovary becoming a large capsule with four inflated valves. The various stages of flower and fruit are shown in Fig. 2, which should make the foregoing description clearer.

RELATIONSHIPS.

Cape honey-flower, as its name implies, is a native of South Africa, and it belongs to a very small family of plants. It may be stated, however, that it was formerly included in a much more comprehensive family, which numbered among its members the maples (*Acer*) and, in New Zealand, the titoki (*Alectryon*) and akeake (*Dodonaea*). Although none of these plants is closely allied to *Melianthus*, the mention of them will at any rate give some hint as to its relationships. Cape honey-flower is apparantly more often confused with the castor-oil plant than any other, as it is often known by this name, which is a most misleading one, the two plants being in no way allied to one another. The only resemblance is in the luxuriant habit and in the large leaves, which, however, in the case of the castor-oil plant are not pinnate, but are deeply divided into lobes radiating like the fingers of the outspread hand. This difference alone is enough to distinguish the two plants at sight.

POSITION AS A WEED.

It has been already mentioned that Cape honey-flower has long been known as a garden-escape, having been so recorded as far south as Wellington many years ago, but hitherto, like most introduced plants of garden origin, it has remained negligible as a weed. Recently, however, there have been indications that this state of affairs is not likely to continue, as the following extract from a report by Inspector J. D. Anderson, Kaitaia, will show: "This weed grows very rapidly, and is spreading fast in some parts of the Mongonui County, particularly along the river-banks in the vicinity of Peria, Oruru, and Kenana. I have also noticed a considerable amount of the weed a few miles north of Houhoura. On account of its extensive root-system this plant appears difficult to eradicate when once it gets a hold." Its rapid spread along river-banks would be accounted for on the supposition that it has now found what it has hitherto lacked in the neighbourhood of most gardens—an environment entirely suited to its full development—while its seeds would doubtless be readily carried by water in their inflated capsules.

As regards control, little need be said. Large size, rank growth, and power of spreading rapidly do not alone give a plant the status of a weed, and unless Cape honey-flower is capable of invading land of immediate or potential usefulness it would obviously be a waste of time to attempt to destroy it. If, however, it shows signs of becoming a serious menace (and on this point the Department would be grateful for the observations of local residents) it is to be hoped that the

FIG. 2. CAPE HONEY-FLOWER (MELIANTHUS MAJOR L.).

(*a*) Flower-spike, (*b*) section of flower, (*c*) leafy shoot, (*d*) capsule, (*e*) section of capsule. Section of flower (*b*) natural size; the rest half natural size.

control methods required by the law in those districts where the weed is "declared" may be supplemented by others derived from an intelligent study of its behaviour in competition with other plants and under varied soil conditions.

It should be mentioned that Cape honey-flower is included by Pammel ("Manual of Poisonous Plants") in his list of poisonous plants of the world, but nothing is said of its properties. Von Mueller ("Select Extra-tropical Plants") states that the leaves afford an antiseptic substance and are used in certain skin-diseases.

FARMERS' FIELD COMPETITIONS.

SWEDE-GROWING AT LEVIN.

F. W. GREENWOOD, B.A., Instructor in Agriculture, Wellington.

In July last year at a meeting of a committee consisting of representatives of the Levin Co-operative Dairy Company and the Department's agricultural instructional officers for the Wellington District it was decided, with a view to promoting the growing of supplementary fodder crops by the suppliers of the company, to hold a swede competition.

The following rules were drawn up: (1) Competitors to be suppliers of the Levin Dairy Company; (2) area of plot entered for competition to be one acre, the acre to be marked off at some time prior to sowing; (3) no competitor to enter more than one acre; (4) quantity of seed and variety to be left to the competitor, but the one acre to be sown with the one variety; (5) judging to take place in the second week in April or thereabouts; (6) a detailed record to be kept of everything connected with the plot on a form to be supplied.

As a general aid to competitors the following suggestions were offered: (1) That the land be ploughed twice—a shallow ploughing some two months prior to sowing, and a fairly deep cross-ploughing—or failing the second ploughing the land to be given an equivalent amount of cultivation—say, with disk harrows or with spring-toothed cultivators; (2) that the quantity of manure applied should be about 3 cwt. of some phosphatic manure; (3) that the plot be top-dressed with 1 ton of crushed limestone some six weeks before sowing. No suggestions were made with regard to the width of drills, ridging, after-cultivation, &c., as it was thought that much of the educational value of the competition would consist in leaving these details to the discretion of the farmer.

In regard to judging, it was decided that points be awarded on the following basis: (1) Treatment prior to sowing; (2) fertilizers, seed, &c., used; (3) treatment after sowing; (4) yield (weighings to be taken from three average places); (5) freedom from disease; (6) trueness to type; (7) records kept.

Each competitor was required to fill in a form giving full details as to previous treatment of paddock, previous crops, cultivation prior to sowing, manuring, liming, quantity and kind of seed sown, width of drills, subsequent cultivation, &c.

The crops were judged and weighings taken on 8th and 9th May. Places were allotted as follows: 1st—D. Laing, 51 tons 16 cwt. per acre (Elephant variety); 2nd—R. A. Rolston, 47 tons 12 cwt. (Superlative); 3rd—W. Tye, 33 tons 14 cwt. (Superlative).

It must be borne in mind that the yield constituted only one factor in the placing of the competitors. Sixty per cent. of the competitors grew the Superlative variety. Other varieties sown were Magnum Bonum, Elephant, Champion, and Webb's Masterpiece. Excluding the first-placed crop the average yields from the plots approximated 35 tons, while excluding both the first- and second-placed crops the average approximated 33 tons. Of the three placed competitors, the first had sown his crop in 28 in. and the second in 14 in. drills, while the third had used 26 in. drills with the turnip

ELEPHANT SWEDES IN 28 IN. DRILLS IN MR. D. LAING'S WINNING CROP.

ridger. All the other competitors had sown in 14 in. drills, with the exception of one who used 7 in. drills. Several competitors substituted double disking for ploughing. In some cases ploughing was not started till the first week in November, while sowing in most cases took place in December. There can be no doubt, especially on dirty ground, that a longer fallow of, say, three months, with frequent cultivations and harrowing after ploughing operations had been completed, would have proved beneficial in keeping the ground free from weeds.

So far as this competition is concerned, there is no evidence to show that lime had any direct effect on the crop, even so far as the minimizing of club-root was concerned. Where, however, it is intended to sow grass after swedes or rape there can be no doubt that the palatability of the pasture will be increased by liming. Moreover, in cases where stiff clay and swampy lands are used its benefits are undoubted so far as the improvement of soil-texture is concerned.

The winning competitor used superphosphate after quicklime. This method of manuring has proved a good one in various parts of the Wellington District during the past season. Its chief drawback is its relative expensiveness. On account of its acidity superphosphate alone used with swedes in the Levin district would generally tend to encourage club-root.

Inspection of the competing crops gave ample evidence that in almost every case the yield could have been increased had they received proper treatment. The most obvious cause of failure was the dirty and weedy condition of the poorer plots. In several cases good work was done until the crop was sown, but after the swedes began to come away neglect of after-cultivation was only too apparent. In some cases, again, the dirty condition of the ground was aggravated by late ploughing and too short a fallow. As has been mentioned, the majority of competitors sowed in

SOME BULBS FROM MR. LAING'S CROP.

[*Photos by E. M. Bates.*

14 in. drills, thus making intercultivation by horse-drawn implements an impossibility. In the majority of cases the dairy-farmer finds that hand-hoeing takes up too much of his time, so that the unfortunate outcome of a 14-in.-drill sowing is generally that the crop is left to take its chance. There can be no greater fallacy than for the farmer to imagine that close sowing must produce a larger crop. In the widely spread drills not only is the use of the horse-hoe between the rows possible, but the individual plant, having more room to grow, has every chance of attaining greater size. In only one case was ridging tried, but there is every reason to believe that had after-cultivation been practised in this case the yield would have been far heavier. It is a noteworthy fact that in many parts of England swedes and mangolds are sown in 32 in. drills. The winning crop yielded 51 tons at an approximate cost of about 2s. 8d. per ton,

whereas the production cost of the average crop was 3s. 6d. per ton, an increase of 10d. per ton mainly through failure to keep the weeds down.

The majority of the competitors employed 3 cwt. of manure per acre. In most cases the fertilizer used was a proprietary brand consisting chiefly of basic phosphate and rock phosphate mixed. Several mixed superphosphate with the proprietary brand or used superphosphate alone.

Practically no crop was unaffected with dry-rot, while in many cases a fair amount of club-root was present. In some instances the ravages of aphis were bad in the early stages, but the new growth of leaves and the wet weather prevented much harm from this source. The hot, moist summer may, moreover, be largely held responsible for the serious menace from dry-rot. Generally, it may be said that mangolds, being immune from this disease, should prove a more suitable root crop in the Horowhenua district, where dairying predominates.

FARMERS' SCHOOL AT RUAKURA.

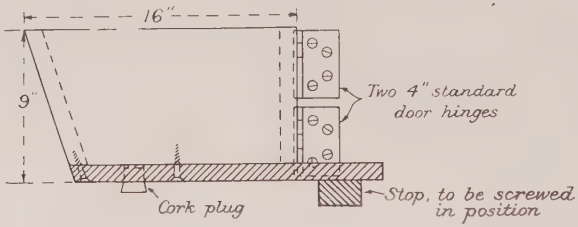
THE fourth annual school for farmers at the Ruakura Farm of Instruction, Hamilton, was held during the week 15th to 20th May. Some seventy-five visiting farmers (including several ladies) were accommodated on the farm, while the course was also attended by many farmers of the neighbourhood, the total attendance at some of the lectures reaching 135. For the formal opening, which was performed by Dr. C. J. Reakes, over two hundred guests assembled at the homestead, where they were entertained by Mr. and Mrs. A. W. Green. The course of lectures and outdoor demonstrations followed generally the lines of last year's school, though the syllabus was somewhat lightened. The subjects and respective lecturers comprised the following: Manures and manuring (T. H. Patterson); farm horses (S. Burton); soil-fertility and soil-types (P. W. Smallfield); feeding of dairy cows (A. H. Cockayne); lucerne (W. S. Hill); Nauru phosphate (A. F. Ellis); farm-drainage (R. F. Callaghan); handling of milk and cream (W. Dempster); principles of pasture-establishment (E. B. Levy); poultry-breeding (E. C. Jarrett); farm forestry (P. M. Page); dairy breeds and breeding (A. E. Missen); wool-handling (J. G. Cook); the cow in health and disease (S. Burton); vegetable-growing (T. W. Roach); swine husbandry (K. W. Gorringe); forage-crop rotations (P. W. Smallfield). The very popular and instructive "farm strolls" were again taken by Mr. Green, and demonstrations of various farm operations were also given. The general management of the school was, as previously, in Mr. Green's hands, while Messrs. A. H. Cockayne and T. H. Patterson were associated in the organization of a very successful programme.

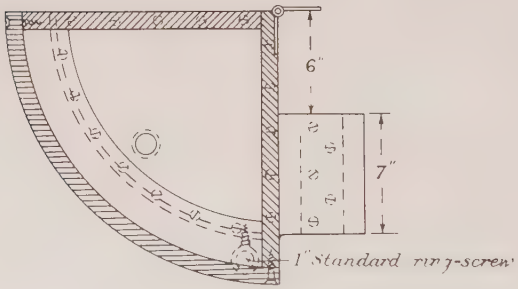
Kohlrabi has been found at the Puwera Experimental Area, Whangarei, attacked by a bacterial disease which is probably *Pseudomonas campestris*. In the Auckland Province, as elsewhere, kohlrabi is usually particularly free from disease.

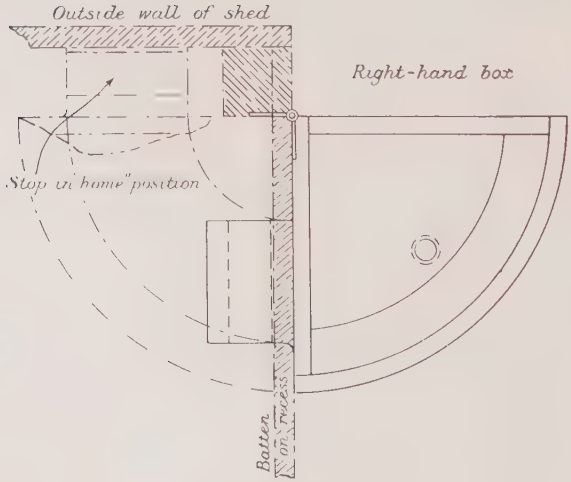
Poa aquatica is a rank grass that throws a great quantity of feed, which, however, is somewhat dry and little suited for dairying, though good for fattening. It will grow for months under water and then come away with great vigour. The leaves look like young raupo-leaves and resemble them in general structure, but are much more nourishing. The plant grows best in rich swamps, and spreads both from seed and from the roots. It puts out long vigorous underground stems which throw up a shoot from every joint. This grass does well in all parts of the Waikato; it also grows luxuriantly in the swamp lands about Foxton.

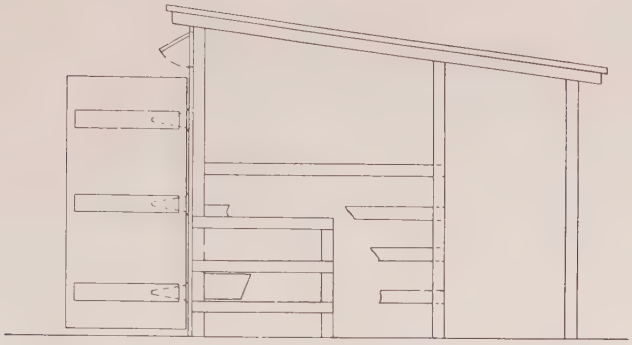
FEEDING OF COWS IN WALK-THROUGH SHEDS.

THE accompanying drawings illustrate a method by which concentrates may be readily fed to cows in walk-through milking-sheds—a matter which has hitherto presented a problem to dairy-farmers. The device—a self-adjusting and disappearing feed-box—has been installed at the Pukeora Sanatorium Farm, Hawke's Bay, under the supervision of Mr. J. L. Bruce, Superintendent of Experimental Farms. Further particulars will be given in a later issue of the *Journal*.

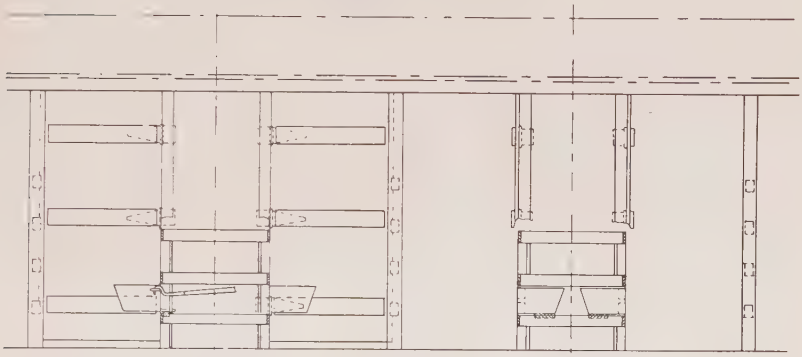




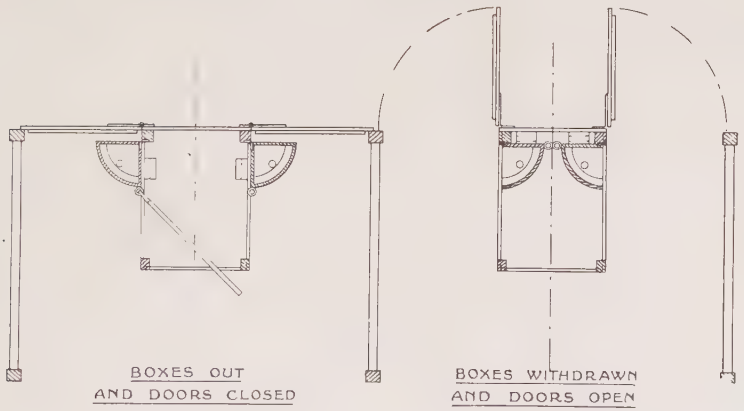




SIDE VIEW OF STALL



VIEW LOOKING INTO STALLS



PLAN

CORRESPONDENCE.

HILL PASTURE IN THE NORTH ISLAND.

MR. CLAUD H. WILLIAMS, of "Coventry," Muriwai, Poverty Bay, sends the following useful notes to the Editor :—

The improvement, or rather the prevention, of deterioration in our hill pastures is one of the most important agricultural questions of the day in New Zealand, and it was pleasing to notice various aspects of the subject so well dealt with by Mr. E. Bruce Levy in the article of his "Grasslands" series which appeared in the March number of the *Journal*. In the case of extensive areas of the North Island the process of deterioration is steadily going on, and though it may be hardly noticeable in the short period of a single year, or even of two or three years, a comparison of results gained to-day with those of twenty years ago will, in many if not in most cases, prove that the quantity of stock that can be carried is diminishing. The type of country I have in mind is the rich or the second-rate steep country of Poverty Bay and the East Coast, and, to a lesser extent, of Hawke's Bay—country which the plough can practically never touch.

The process going on is the gradual intrusion of inferior grasses, and their ultimate preponderance over the valuable English grasses which were the first result of clearing and surface-sowing. Country which for a few years after clearing—whether from manuka, fern, or bush—held a thick sward of rye-grass, cocksfoot, Poa pratensis, and white clover is now a mixed pasture of English and native grasses, the former gradually weakening, the latter taking possession. There is great difficulty in defining the extent of the deterioration, for improvement in farming methods is always going on, and the increase of carrying-capacity due to smaller subdivision and more efficient management is often more than sufficient to counterbalance the loss due to inferior pasturage. I venture, however, to submit a few observations from my own experience on typical Poverty Bay hill country—mixed rich and second-rate land—during the past fifteen years.

I have followed a system of comparatively light stocking with sheep and heavy stocking with cattle, combining beef-production with sheep-farming. Such conditions should tend to preserve the quality of the pasture, and doubtless they have done so to a great extent, but the run has a lower carrying-capacity to-day than it originally had. The reason, I think, is not far to seek. Persistent light stocking with sheep simply means that the superior grasses only are eaten, the inferior gradually gaining the ascendency. Frequent spelling of the country from sheep is a help to the former, but that is only one-half of the problem; frequent overstocking is necessary to reduce the latter. My theory is that on equal terms the English grasses will beat the danthonia, and this is based on two facts. If an area of mixed pasture is fenced off from stock, whether for a plantation or for any other purpose, in a few years the sward will be almost entirely cocksfoot or rye-grass—that is, provided the land is suitable for English grasses. Again, it may be noticed that when a large lightly-stocked property is subdivided for smaller settlement the first result of the overstocking which is so common amongst small farmers is a distinct improvement in the pasture and in the carrying-capacity. Persistent overstocking must, of course, weaken the grass, but the first result is improvement. Thus English and native grasses are on equal terms whenever the country is either quite empty of sheep or is greatly overstocked. If my ideas are correct, pasture will tend to improve on country in which these two conditions are constantly alternating. It is obviously impossible to attain these conditions during winter and spring, except for a small proportion of the country, but during summer and autumn it is a simple matter to make it the rule with the greater part. Subdivision into comparatively small areas makes it possible to run grown sheep always in considerable numbers, and frequent shifts will prevent any hardship to the stock.

The experience of a complete twelve-months' spell from sheep in the season 1920–21 in a paddock of 280 acres here was very striking. Before the experiment the area appeared to be a mixed pasture, with danthonia largely predominating. All the stock (sheep and cattle) was removed early in September. After a month all the better parts of the country appeared to be almost pure rye-grass and Poa

pratensis. In the early spring the English grass grows much more rapidly than the native, and in this case completely overshadowed it, except on the hard dry faces where only danthonia had survived. Early in December, when the rye-grass seed was sufficiently forward to germinate, 150 fattening-bullocks were put in, and these remained and did well for three months. Their place was taken by an equal number of store cattle, which remained until the autumn rains fell. Though the rain was very late that season, every bare patch and sheep-track was a mass of young grass-plants in a few weeks, and when these were well started the paddock was stocked with 130 breeding-cows for the winter. The result was a palpable increase in the vigour of the English grasses, but for how many years this improvement will continue remains to be seen. One error was made, and that was in removing all cattle at the same time as the sheep in September. In ordinary seasons enough cattle should be kept on to prevent the grass getting too rank and lying down. They can be removed just before the seed-heads begin to come out. The financial result was all to the good, chiefly because of the exceptionally dry season. It was possible to fatten an extra 100 bullocks and to winter the whole breeding-herd thoroughly well. We came through a very bad season with hardly any mortality in cattle.

I am aware that many sheep-farmers habitually empty part of their country from sheep, but it is generally done much later in the season. In my opinion, the crux of the matter is to secure the early spring growth of the English grasses. This, of course, means wintering a less number of sheep.

I venture the following opinions in the hope either of contradiction or support from sheepmen of wider experience than myself: For the preservation and improvement of our mixed hill pastures—(1.) Persistent overstocking is injurious, but occasional overstocking either with sheep or with cattle is essential. All feed should be eaten off bare at least once a year. (2.) Persistent light stocking is injurious; country which is lightly stocked for lamb-raising or for fattening should be stocked hard after its purpose is fulfilled, in order to eat out the feed which has been neglected. (3.) Occasional spells from sheep are necessary, preferably during periods of strong growth and after very heavy stocking. (4.) When country becomes stale or sheep-sick and slow to respond, a complete twelve-months' rest from sheep is necessary. No sheep whatever should be put on, but cattle can be grazed in large numbers.

With regard to the last-mentioned point I estimate that about one-tenth of the whole pasturage should be receiving this complete rest each year. This would mean that 10 per cent. less sheep could be carried, which looks like an expensive matter. But against this loss in sheep would be a gain in cattle, and as country under treatment will provide excellent beef feed, even with the present values for cattle the loss should be balanced. Furthermore, the flocks on the older country should cease to diminish.

P.S.—Where pastures are fairly thick and the country is free from bare patches it should not be necessary to allow the grass to run to seed. Each year a proportion of the land may be used for cattle only. An area from which sheep are rigorously excluded, and which is used as a beef-paddock for a complete year, is invariably the better for several years afterwards.

STOCK SLAUGHTERED, 1921–22.

THE following are the numbers of stock slaughtered at abattoirs, meat-export works, bacon-factories, and ordinary registered slaughterhouses throughout the Dominion during the year ended 31st March, 1922:—

Stock.	Abattoirs.	Meat-export Works.	Bacon-factories.	Ordinary Slaughterhouses.	Totals.
Cattle ..	107,180	97,907	..	56,631	261,718
Calves ..	21,035	9,585	..	1,672	32,292
Sheep ..	763,177	3,071,255	..	292,794	4,127,226
Lambs ..	175,506	4,876,555	..	33,206	5,085,269
Swine ..	84,198	61,001	31,696	17,752	194,647

WORK FOR THE COMING MONTH.

THE ORCHARD.

ELIMINATING INFERIOR VARIETIES.

At this season of the year pruning is one of the chief operations claiming the attention of the orchardist. While this is under consideration another phase of successful fruitgrowing should not be overlooked—namely, the elimination of inferior and unprofitable varieties. Some trees require eradication for various reasons, being "bad doers," or too badly attacked with disease to warrant persevering with. Trees of this class should be removed entirely and replaced by new trees; but outnumbering these by far is the large number of inferior varieties that can be found in many orchards. While the latter conditions may apply mainly to the older orchards planted many years ago, quite a large number of the class of trees referred to are to be found in orchards planted within recent years and which are now coming into bearing. The would-be commercial orchardist will be well advised to weed out such varieties by grafting the trees to recognized commercial varieties that may be expected to hold their own in competition on the various markets which form the outlet of the fruitgrower's production.

Although these remarks chiefly concern growers of pip-fruits, there are also instances where they are equally applicable to those growing stone and citrus fruits. As the trees become older and crops heavier it is with increasing reluctance that the fruitgrower can bring himself to that frame of mind in which he will make the necessary sacrifice of the bearing tree, knowing that some time must elapse before it can be replaced in the same capacity at which it stands at present. But the effort made will be recompensed all the sooner the earlier it is carried out, and every season allowed to pass without this work being undertaken only postpones the general advancement and ultimate success of the orchard. Already our export markets are sorting out the inferior varieties of apples which do not realize enough to pay shipping-expenses, and it is found that the demand is no better for this class of fruit on the local markets, where it is being displaced by standard varieties of better quality.

Where a considerable amount of this weeding-out is necessary it can be extended over a season or two by taking out a proportion each year, but it may be repeated that the sooner the whole operation is completed the sooner will the ultimate benefit be gained. Those trees selected for treatment in this manner should be cut down now to a height a little above that required for grafting purposes. The debris can then be removed along with the prunings from other trees. Fresh cuts will then be made when grafting takes place in the early spring. Scions of the varieties decided upon for replacing should be carefully selected in the meantime and placed in a cool shady place, where they may be covered with light sand and kept until the grafting season arrives.

—W. T. Goodwin, Assistant Director of the Horticulture Division.

AUCKLAND.

Pruning operations may now be pushed ahead with all vigour, first attention, of course, being paid to the pruning of stone-fruit trees. Those growers who are able to finish off their stone-fruit pruning and commence work on the pip-fruits before the end of this month are warned to keep a sharp lookout for cankered areas on apple, pear, and quince trees. Should any such areas present a sunken appearance, or otherwise have the slightest resemblance to fireblight hold-over cankers, they should be immediately removed and the wound painted over with corrosive sublimate, 1–1,000 (one tabloid to a pint of water), and, when this has dried, again painted over with coal-tar. Owing to the fact that no fireblight infection was experienced in the commercial areas in this district during the season just past, it is likely that some growers may consider this work unnecessary. Every precaution should be taken, however, as it does not in any way follow that because there was no infection last season there will not be a recurrence of the previous season's infection next year.

The planting-out of all strawberries should be completed as soon as possible, and every available opportunity should be taken to ensure the completion of this work.

Intending planters of new citrus areas are advised not to set out the trees into permanent positions until such time as the risk of frosts is over. The young trees do much better at this season if they are kept heeled-in, and are covered over with scrim at night to prevent injury from this cause. The planting of other classes of fruit-trees may now be carried out where soil conditions are suitable —where the soil is in a moist yet not saturated condition.

—*J. W. Collard, Orchard Instructor, Auckland.*

HAWKE'S BAY.

At this season open drains should be cleaned out, pipe-drain outlets examined and cleaned if necessary, and drainage provided for low-lying parts of the orchard. Trim, top, thin out, or plant additional shelter as required.

The pruning of deciduous fruit-trees will be the main work of the month. A thorough clean-up should be made of all prunings, and the refuse destroyed by burning. Collection of prunings is greatly simplified when a sheet is spread under the tree being pruned. The best method is to use a large sheet similar to a tent-fly and equal in diameter to the average tree to be pruned. With a slit made from one edge to the centre this sheet is easily spread under the tree. When pruning of the tree is complete the sheet may be pulled over in such a manner as to pile all the prunings on the land between the trees, in this way leaving them in heaps ready for removal and destruction. Where trees are to be grafted they may now be lopped down to some little distance above the point where the grafts are to be inserted, thus allowing all refuse to be cleared away in good time. A clean cut should be made later at the time of grafting.

When stone-fruit trees have been pruned they should receive an application of lime-sulphur, 1–12, or oil, 1–17, for scale insects, to be followed by bordeaux, 8–6–40, at the burst of bud, for fungoid diseases.

Planting of all classes of fruit-trees may be carried out when the land is in a suitable condition.

—*W. H. Rice, Orchard Instructor, Hastings.*

NELSON.

Pruning is the most important operation in the coming month. Some of our heaviest losses are due to unskilful pruning. The matter should be given careful consideration; it is the chief factor in obtaining good crops. Where large cuts are necessary, make them carefully and dress the wounds with coal-tar, which may be thinned with creosote if too thick. Recent experience has stressed the need of removing decayed branches and snags from fruit-trees. Many valuable trees have been lost lately by omitting to do this work and that of cutting out cankered areas and dressing the wounds.

Gathering the litter after pruning is a big undertaking in a large orchard, and the prunings are often tipped into a gully or piled on a wide headland and left to decay. Only a very elementary knowledge of fungus and insect life is required to know the seriousness of this mistake. If prunings are piled in this way they should be promptly burnt; they burn fiercely when half-dry, which is very soon after pruning. A better plan is to use a fire-cart; commence by starting a good fire in the tank, and the prunings may then be gathered and burnt while the cart is travelling through the orchard.

Where regrafting has to be done later, select the scions with great care from trees of the best type only, and heel them in at once.

Plantation and shelter planting are receiving a great deal of attention this season. The orchard, no doubt, will be greatly benefited by the shelter provided, while the higher ridges and steep broken faces on the hills will be turned to good account. Push the planting along when the ground is reasonably dry, taking special care that the roots of young trees are not exposed to the sun and wind.

—*W. C. Hyde, Orchard Instructor, Nelson.*

CANTERBURY.

The most important work during June and July is pruning, which in large orchards must be pushed on as fast as possible so that it will be completed before the trees break into growth in the spring. A fact which must be kept in mind is that every tree has its own individuality, and a careful study should be made

of the habits, fruitfulness, general development, and age of the different trees. As the primary object of pruning is for profit, unnecessarily hard cutting-back, which would induce excessive growth, must be avoided. Strong-growing trees should be pruned lightly to maintain their shape and to avoid causing excessive growth. It must not be expected that pruning will overcome weakness in trees caused by unsuitable soil conditions and disease. Growers who are not acquainted with the principles and objects of pruning should get in touch with the Orchard Instructor for their district and obtain instruction. All prunings should be gathered and burnt as soon as possible. While working around the trees always keep a sharp lookout for disease, and note affected trees. Weak trees should be marked so that special treatment may be given in the spring.

Unprofitable apple, pear, or other trees which it is intended to graft in the spring should be cut down carefully to a point just above where the scions are to be inserted. The wood removed can then be taken away and burnt with the prunings.

During the winter months advantage should be taken of the rainy days to clean, oil, repair, or paint harness, tools, implements, &c. The spray-pump should be the first to receive attention, and the whole outfit put in good working-order.

Ploughing should be completed as early as possible. At the Rothamsted Experimental Station it has been found that land ploughed in the autumn benefits more than that ploughed in midwinter.

Green-manure crops which have attained sufficient height should be ploughed under, so that the material may rot and the nutriment which it contains become available to the trees in the spring.

Fruitgrowers' instructional classes: All fruitgrowers and other interested persons are invited to become members of these classes, which are held in Baket Brothers' Buildings, Manchester Street, Christchurch, on Monday evenings at 7.30 p.m. sharp. Upon application a syllabus of the lectures to be given may be had from the Orchard Instructor.

—W. K. Dallas, Orchard Instructor, Christchurch.

OTAGO.

Pruning will still be the main work for July, but the orchardist must not neglect his ploughing (if this is not already done), attention to drainage and shelter-hedges, and general renovation work. Above all, it must be remembered that merely getting through the work is not sufficent—it must be well done. Thoroughness pays in all work in connection with the orchard.

All cuttings and branches removed by pruning should be burnt, especially where powdery mildew and silver-blight were present last season. Towards the end of July spray with red oil for control of red mite and mussel scale, at the strength of 1-8 for pip-fruits and 1-12 for stone-fruits. Spraying at weaker strengths for these two insects does not give very satisfactory results in this district.

—B. G. Goodwin, Orchard Instructor, Dunedin.

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

EARLY HATCHING.

If stock of the heavier breeds, such as Orpingtons, Wyandottes, Rocks, &c., are to be developed into profitable birds, hatching operations should be initiated early in the coming month. Indeed, under certain local conditions, and particularly on larger plants, it will pay to start hatching out White Leghorns and similar types of bird right away. Especially is this the case when the hens have resumed laying after going through the moulting process, and their eggs are available for hatching purposes.

Necessarily, chickens hatched at this period of the year, particularly in the case of the lighter breeds, cannot be expected to produce many eggs during next winter. In all probability they will commence their season of production during the late summer, and will terminate it at about the end of April, or perhaps later, and will then moult, like the adult fowls, during the dear-egg season. In this way they give a good return of eggs at a time when the great bulk of the adult birds are taking a rest prior to moulting. Thus a good autumn egg-yield is maintained.

Another advantage in having some early hatched chickens is that these, whether they be males or females, usually develop better than those brought out later, and are therefore more desirable for breeding purposes. Of course, when winter eggs are the great objective aimed at it will usually be found that the best time to hatch White Leghorns is during September.

I would again emphasize that every care should be taken in selecting eggs for hatching purposes. No eggs should be used that are on the small side. Unfortunately, too many of our heavy-laying strains in these days are producing eggs which are certainly not of a desirable marketing size. No doubt the weight clauses adopted in the egg-laying competitions will have a desirable effect in this direction. The same may be said in regard to the rule adopted at the Papanui competition under which diminutive types of their breed are not allowed to compete. This is a golden rule, and the sooner it is adopted at other competitions the better it will be for the industry generally.

REARING UNDER THE HEN.

Where the natural method of rearing is adopted every care should be taken to protect the hen and her young ones and to provide against accidents. The coop should be both cat-proof and rat-proof. In addition, in view of possible wet weather, a boarded floor should be provided for the coop, so that the chickens may be kept off the wet ground. Again, when the chickens are hatched any board surrounding the nest should be removed, so that in the event of the chickens leaving the nest they can return to it with ease. It is surprising the number of chickens that are lost annually through getting out of the nest and being unable to get back to it. Many chickens have also been drowned by jumping into deep water-vessels. Minimize this risk by placing pieces of brick or stones in such receptacles, or, better still, use a shallow water-tray.

In setting a hen the best plan is to make the nest on the ground, and if a box is used the bottom should be taken out of it. The nest should be slightly hollowed out in the centre, or, in other words, saucer-shaped. The hen should be tested with a few china eggs until it is shown that she will sit steadily and can be entrusted with the eggs intended for hatching. These should be placed in the nest in the evening. Much annoyance and trouble may be avoided if this precaution is taken.

The food for sitting-hens should consist of whole grains, maize being included when available. This with grit and clean water is all that is required. Mashes, meat, and green food are apt to slacken the bowels and cause the eggs to be soiled, to the detriment of the hatch. When the eggs commence to pip do not interfere with the hen—she can manage best by herself. It is only courting trouble to take the chickens out of the nest as they hatch; they should be left to the care of the hen. Chickens do not require food for at least a day after hatching.

Do not neglect to see that the hen is free from vermin. Many fowls leave their eggs just when they are on the point of hatching, because they are being pestered beyond endurance by lice. Before the hen is set the coop should be well disinfected to make sure there is no red mite present, while the hen herself should be dusted with insect-powder before being placed on the eggs, this in order to free her of vermin that live on the body. A dust-bath should also be provided so that she can clean herself in nature's way. Be careful not to powder the hen with anything of an irritating nature just after the chickens are hatched, as this may get into the eyes of the chicks and blind them.

CONTINUOUS HOUSING FROM THE BREEDING ASPECT.

Of late I have come across many new poultry-keepers who have adopted the continuous housing system with no provision whatever for outside runs. It is claimed that under this system the number of birds which can be kept on a given area of ground can be enormously increased, while the work of attending to the stock can be greatly reduced It is also claimed that young stock can be reared in these covered quarters from generation to generation possessing equal vigour and size to those developed under natural conditions with good range. That pullets may be placed in one of these commodious houses with ample scratching-accommodation and lay well is undeniable, but it has yet to be demonstrated to the writer that the pullet reared under these extreme artificial conditions can be brought to maturity possessing the same vigour and capacity as those reared under more natural surroundings.

From a breeding point of view, where constitution is of prime importance, it cannot be expected that birds coddled from infancy to maturity and bred in this manner from generation to generation could be looked upon as desirable parent stock. At any rate, on the great majority of plants coming under my notice where stock have been bred and developed over a period of years under the closed-in system, such birds have little or nothing to recommend them as breeders when compared with the general run of flocks bred from parents on a good range where the progeny are developed in practically a state of nature.

The closed-in house is at its best when used only for laying-flocks. True, the modern high-typed laying-hen is an artificial product, but if she is to be bred to and maintained at the highly profitable standard to which human wit and experience have brought her, the demands of nature must be observed very closely or something will suffer as a consequence. Thus it should be the aim of poultrymen to rear birds in as natural a manner as possible, without, of course, permitting them to be subjected to undue extremes of weather. The possession of constitutional vigour is one of the great fundamental requirements in breeding heavy-producing stock, and I cannot imagine any better way of promoting this than by giving the breeding-stock and their progeny, especially during their developing stage, the most natural conditions possible.

THE APIARY.

F. A. JACOBSEN, Apiary Instructor.

WINTER WORK.

DURING the ensuing months there will be little to do in actual beekeeping-work. Manipulation of the colonies must cease on account of the cold weather, and other work of this nature must be set aside until the spring. The chief thing is to see that none of the colonies starve, as losses of this kind, when made in the winter, spring, or early summer, detract considerably from the following honey crop. To secure an increase in colonies without material loss in strength in the individual hives requires a considerable amount of time and labour, and should a bad spring be experienced expense will also be incurred. It pays, therefore, to look well after colonies already formed, and from 30 lb. to 40 lb. of sealed stores should have been left at the disposal of each colony at the commencement of winter, thus assuring strength in the spring. Do not at any time disturb the cluster of bees.

Should it be found necessary to give additional feed, this should be placed alongside the bees inside the hive. A comb of clean sealed honey or a cake of candy is best. Do not feed honey from a doubtful source, as it may contain the spores of foul-brood. Some beekeepers prefer to feed sugar-syrup in the spring, and so stimulate the bees to start brood-rearing earlier than they otherwise would do. This is sometimes advantageous and even necessary, but at the same time a colony will require less attention and do equally well if left with plenty of winter stores.

It is a good plan to remove damp mats from the top of the frames and replace with dry ones. Damp mats also indicate that the cover or roof requires repairing, and this should be attended to.

LIQUEFYING GRANULATED HONEY.

Many of the public still have doubts regarding the purity of honey when it is granulated—that is, when it is in the solid crystallized form. Consumers have speculated on the point, some declaring that sugar had been mixed with the honey to bring it to that form. Such, however, is not the case, as practically all honeys throughout the Dominion granulate, and it is usually found that when foreign matter is introduced the granulation process is greatly retarded or stopped altogether. Thus, if honey is in a granulated form, this condition is, to the layman, one of the best indications of its purity.

It is frequently desired that honey be consumed in liquid form, and in this case the glass jar or tin containing the granulated article should be placed in a vessel of water at a temperature of about 150° F. This heat should not be exceeded, as otherwise the aroma and flavour may be seriously affected or destroyed. Sometimes, according to the solidity of the granulation, the honey may take as long as three hours to properly liquefy. It is advisable to place something under the tin or jar to keep it from direct contact with the bottom of the heating-vessel.

VITICULTURE.

J. C. WOODFIN, Vine and Wine Instructor.

VINEYARD AND CELLAR.

CONTINUE the pruning of the vines, burning all cuttings, and apply manure. Commence winter ploughing to facilitate the drainage of surface water and the aeration of the soil. Exposing the earth to the action of the air and frosts pulverizes it, and renders it much easier to work later on. The winter ploughing should be the deepest. The ground should be ploughed down to the thick roots, increasing the depth as the furrows are more distant from the vines. In rich, loose soils the fibrous surface roots destroyed by the plough are rapidly reconstituted. In the more solid clays, owing to the greater resistance of soil of this nature, these roots take a longer time to develop. Ploughing under the latter soil conditions should therefore be shallow—not deeper than 4 in., or even less, near the vines and 6 in. in the centre of the rows.

Continue racking the new and old wines, choosing the cold, fine days. When the barometer is low and atmosphere warm and muggy the lighter constituents of the lees are liable to rise in the wine, rendering it cloudy and unfit both for racking and for bottling. The vats and barrels of dry and unfortified wines should be kept filled to the bung to prevent the growth of the *Mycoderma vini*, or "flowers."

THE VINEHOUSE.

Vines under glass will in most cases have been pruned, but some will yet remain to be done. Some inexperienced people, and also others who ought to know better, cut much too close to the buds. This is bad practice. The laterals proceeding from such buds are left with very little foundation, which in many cases is the cause of laterals falling off. The loss of a lateral may be a serious matter, resulting in a barren spur. Before pruning each spur should be examined—a glance is sufficient—and the bud to be fostered decided on. A well-formed bud should be chosen; there may be one or more weaker buds below it; a prominent bud should be kept. Instead of cutting close to the bud, leave at least half an inch of lateral above it.

A certain proportion of the old bark becomes loosened, and, if left, would in time be shed. This loose bark should be removed, the vine having done with it. The practice some have of stripping the rods bare is barbarous, and, besides being a great waste of time, it has a weakening effect on the vines. Were it not that loose bark provides shelter-places for mealy bugs it would be best to leave all but hanging strips, and this should be done where there are no bugs. In any case no bark should be removed that is not partly loose. If mealy bugs are present, or if thrips or red spiders have been troublesome, the rods should be washed with a weak solution of Gishurst's Compound in hot water. Use a scrubbing-brush and clean them well. Do not scrub the buds, but pay particular attention to the rough places immediately around the buds. After washing the rods, dress them with the compound as per directions on the box. All the prunings, dead leaves, strips of bark, and any other rubbish should be carefully cleaned up.

In cases of bad infection with mealy bug the whole house should be thoroughly cleansed, including the floor. A thorough syringing or forcible spraying with kerosene emulsion, 1 in 12, will kill all live bugs it reaches, and flood out a good many of their eggs. Force the spray into crevices as much as possible, as in such places the bugs hibernate and breed.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

BY the time these notes are published early cabbages should be well advanced in growth, but any one not having planted may still do so. The kinds referred to are those of Flower of the Spring type, which are very small and head early. They may be planted 12 in. apart in rows about 20 in. or 22 in. apart. This allows ample room, the plants not being likely to cover the space between the rows. The

purpose of these small varieties is to supply very early heads. Cutting should begin as soon as the heads are well folded, not waiting for full development. About the second week in July two rows of carrots may be sown between each two rows of cabbages. The cabbage-stumps can be drawn when the heads are taken, so that when the cabbages are used up the carrots occupy the ground, thus giving two crops with one preparation of the soil. Larger varieties of cabbage to succeed the early varieties should be planted at once or within the next few weeks, in order to supply a succession of heads.

Cauliflowers: There are two types—the small-headed, which come to heads in a comparatively short time, and the large-headed, that take a longer time to make heads. There are two periods when cauliflowers have a special value, whether it be in the private or the market garden: these are from early spring to well into December, and in the autumn. By the end of December—earlier in some places—French beans come in to supplement peas. Cauliflowers are of less value while these supplies last, but when they are gone cauliflowers are again appreciated. The earliest to head are the small varieties, such as Early London, Early Eclipse, Snowball, &c. These varieties, being so quick in heading, are liable to head prematurely, and they therefore require special care. In a former issue it was advised that the seedlings should be pricked off as soon as they could be handled, or, as an alternative, that the plants should be thinned to prevent crowding. To prevent premature heading, or buttoning, it is necessary to keep the plants growing with the least possible check. When plants are drawn from a crowded bed they have very few roots, and those they have are more or less broken in lifting. Such plants are some time getting a hold on the soil, and a considerable check results. When the young seedlings have been pricked off there is practically no check from transplanting, as they have a good supply of roots, and they are not injured in lifting. When the plants have commenced to grow freely a little nitrate of soda will push them on. At the same time as the early sorts are planted, or soon after, a planting of a large kind should be made. These take longer to head, and will succeed the earlies. There is practically no danger of the former bolting, but they also should be pushed on by giving nitrate of soda; it pays, owing to the larger heads produced. By larger kinds the Autumn Giant types are meant. Early Erfurt is not a true early, though classed as such in some catalogues. It is a large-headed variety coming a little quicker than the Autumn Giant types. It is on that account a valuable sort to grow where a continuous heavy supply is of importance. The autumn supply previously mentioned is provided for by sowing seeds about the middle of September.

Lettuces should be planted in quantity; they will come in at a time when most appreciated. Sow more seed as soon as the soil is fit. In places subject to hard frost the seeds are best sown under a glass light, but the open ground is preferable where this is possible.

Peas: Early in July sow a dwarf kind for first use. At the same time sow a medium tall variety to succeed the dwarf. When these are well through the ground sow again a medium or taller variety, and from then onward till January sow every fortnight.

Onions: Where the soil and climate are suitable, onions should be sown in July. The best time for sowing, of course, varies considerably in different districts. It is useless to sow until conditions of soil and climate are right, but the earlier this is the greater the chances of success. Sowing should never be done until the surface soil is sufficiently dry to secure a good seed-bed. Planting out autumn-sown plants should also be done as soon as the soil is in a fit state.

Carrots: A first sowing should be made as soon as possible, as those now growing run to seed in spring. This occurs regardless of when they were sown, summer or autumn. Early Horn varieties are best for the first crop, as they are usable while very young.

Shallots and garlic should be planted at once. Press the bulbs into the surface of finely pulverized soil, leaving the top visible. Plant 10 in. apart in rows 12 in. apart. If the cloves of shallots are broken off from the parent bulb and planted about 4 in. apart in rows they come along quickly and make a very good substitute for spring onions. Onions that are not keeping well may be planted out, the green tops being useful for flavouring purposes.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

EFFECT OF SMUTTED OATS ON STOCK.

"X. Y. Z.," Ravensbourne :—

This year my oats were badly affected by smut, and I should be obliged if you would inform me to what extent this will render the chaff injurious to horses and to cows in milk, and also state whether smutted oats fed green to cows would be likely to reduce the quantity or test of their milk.

The Live-stock Division :—

Smut (*Ustilago carbo*) is a fungus which attacks growing oats and completely destroys the flowering-head, so that the whole ear disappears and nothing but its framework is left. Therefore the feeding-value of chaff or green oats is reduced according to the proportion of the grain affected by the pest. Smut does not appear to produce any special form of disease in horses or cattle, although it is said the spores have caused serious disease in lambs. The quantity and test of the milk in dairy cows fed on smutted green oats will depend on the degree to which the fungus has destroyed the grain and thus reduced the quantity of nutritive matter.

REPLACING BUFFALO-GRASS PASTURE.

A. C. M. H., Leigh, North Auckland :—

About three-quarters of my farm is in buffalo-grass. Should this be eliminated as soon as possible or a certain amount retained? What is the relative food value of this as compared with other grasses for dairy cows?

The Agricultural Instruction Branch :—

Buffalo-grass is a poor feed, and quickly becomes root-bound, when it throws little herbage. If a large part of your farm is in this grass the eradication of it should be done gradually. This can be done by thorough cultivation followed by a smother-crop. Limited cultivation only tends to rejuvenate the grass. The surface should be broken in the late spring by skim-ploughing, the sods cut up with the disks, and the roots dragged out with a tine cultivator, rolled up with the chain harrows, and burnt during dry weather. Then plough deeply (two or three times if possible), and sow down in March with the following mixture: 20 lb. Italian rye-grass; 6 lb. cow-grass; 4 lb. cocksfoot; 6 lb. to 10 lb. paspalum.

PINE-NEEDLES AND LEAF-MOULD.

W. F. Bennett, Scargill :—

I notice that the use of leaf-mould (decayed leaves) is frequently recommended. May I ask whether common pine-needles will do for the purpose. As decayed pine-needles form about the only leaf-mould that many of us can get this question becomes of some importance.

The Horticulture Division :—

The mould from pine-needles has no value for the purposes for which leaf-mould is generally used. Leaf-mould, as understood by horticulturists, is the decayed leaves of deciduous trees. Those leaves that are somewhat hard in texture make the best mould. Sweet-chestnut leaves are best of all; oak-leaves come next; then beech, elm, and ash. Sycamore, poplar, and willow leaves make an inferior but still useful mould. The best state for use is before decomposition is quite complete and while small pieces of the leaves are still visible. This is termed flaky leaf-mould. The mould from a heap of pine-needles is not

fit for use till the needles have been stacked eight or ten years. After that time there will be nothing but a fine mould, useful in the open ground but not for pot-plants or seed-boxes. An indifferent leaf-mould can be got from the floor of native bush. If pieces of dead wood are removed it makes quite a good substitute for the real thing, but never equals it. Very old stable manure—just a black mould—is better than poor leaf-mould. The best way to dispose of pine-needles is to burn them.

DESTROYING WEEVIL IN LOFT.

O. G., Tarakohe :—

I have a large loft, well lighted and ventilated, which has been used for the storage of oaten sheaves, but has become infested with weevil. The loft is now empty, and I should like to take advantage of this opportunity to rid it of the pest. Could you please inform me how this might be effectively carried out ?

The Biologist :—

Fumigation with carbon bisulphide is the most practicable method recommended. The loft should be rendered airtight, and carbon bisulphide exposed in shallow vessels, preferably at a height above the ground, at the rate of 5 lb. for every 1,000 cubic feet of air-space. The loft should be kept closed for at least thirty-six hours, and every possible precaution taken to prevent the approach of naked lights to the highly inflammable liquid.

PROPAGATING THE GUAVA AND PASSION-VINE.

E. SANDERS, Takahue :—

Will you please inform me (1) how the guava is propagated, and (2) if the passion-vine can be grown from cuttings ? In the latter case how should the cuttings be taken ?

The Horticulture Division :—

(1.) The guava can be raised by seeds, by layers, and by cuttings. Plants raised by seeds are not likely to come true to type. The only certain way to reproduce a type is by layering or by cuttings. Cuttings should be made from young shoots just as the wood is becoming firm at the base. Cuttings about 3 in. long are placed in pots of sand, and covered by a bell glass in a greenhouse. Branches can be layered by cutting a tongue at a joint on the under-side ; securely peg it down and cover with soil. Layers should root in one year. (2.) Passion-vines can be increased by cuttings placed under a bell glass in a greenhouse. Cuttings may be short shoots taken with a heel of the old wood, or lengths of the vine of the current season's growths taken when fairly firm. Pieces may contain two joints ; one joint forms the base, and is inserted in the soil in the pot. The best way to get plants is by seeds, which reproduce the parent plant.

LEG TROUBLE IN DUCKS.

M. B., Te Kopuru :—

In our flock of ducks one will occasionally lose all power in its legs and be unable to walk, through no apparent cause, the bird being otherwise quite healthy. Could you kindly advise treatment ?

The Chief Poultry Instructor :—

This trouble may be due to injury contracted through the birds being chased over rough ground, &c. The most common cause, however, is the birds sleeping in damp or wet quarters. Although ducks are waterfowl, it is essential that those which are domesticated be provided with a dry place during the night. There is practically no cure for the trouble in question ; prevention is the only reliable course.

TREATMENT FOR GRASS-GRUB IN LAWNS.

E. HARDING, Woodville :—

What treatment would you recommend for a lawn which was infested with grass-grub (and has been dug up) in order to get rid of the grub ?

The Horticulture Division :—

For established lawns the following treatment is advised : Add 4 parts of carbon bisulphide to 1 part of phenol, mixing well and diluting 1 gallon of the mixture or emulsion with 100 gallons of water. Apply the solution with a watering-can. The application of lime-water is also good for bringing many of the grubs to the surface. As you have dug up your lawn a stronger carbon-bisulphide-phenol solution might be used. The surface of the ground should be well compressed with a roller immediately after the application. Care is needed in the use of carbon bisulphide, as it is very inflammable : it must be kept away from lights of every kind, and the operator must not be smoking. If the material cannot be obtained from a chemist, wholesale druggists can supply.

DRYING-OFF COWS.

M. C., Mihiwaka, Dunedin :—

What is the best method to adopt when drying off cows ? I have noticed that the milk at this time sometimes becomes thick and ropy, perhaps only in one or two teats.

The Live-stock Division :—

In general, the drying-off process should be commenced at least two months before next calving, milking being stopped gradually. Once a day for a fortnight and twice a week for the following fortnight will leave the udder so that it only occasionally needs drawing out. When the animal is a good milk-producer it may be that the supply continues. It is necessary then to make the diet less liberal and give dry food, such as hay, with an occasional dose of physic. Epsom salts, 12 oz. to 16 oz. according to the size of the cow, dissolved with a pound of treacle in a quart of warm water, will serve this purpose. It is important that the drying-off should be conducted with care, or a closed teat or defective quarter after the next calving may be the result. The thick and ropy milk you speak of is sometimes a symptom of such trouble, although stringy milk is often due to other causes, such as digestive disorders and bacterial contamination.

RINGING A BULL.

O. W. GREEN, Takaka :—

I have a seven-months-old Jersey bull which I want to ring. Will you please inform me as to the best and most humane manner of doing this ?

The Live-stock Division :—

In the first place see that the animal is securely fastened. If a nose-punch is available a small piece is cut from the septum nasi—the partition between the nostrils—and the ring inserted. When no punch is at hand a small trocar and canula may be used, this being forced through the septum and the ring inserted into the hole. In some cases, when neither punch nor trocar is available, a self-piercing ring may be used, but this is more painful, as the point has to be forced through the septum.

FREEING GROUND OF CAUSAL ORGANISM OF CONTAGIOUS MASTITIS.

"KIWI," Okoke :—

I have been troubled with contagious mastitis in my herd for some years. If the cows were removed from the paddocks for a year and sheep substituted, would the ground be freed of the germ ?

The Live-stock Division :—

As the vitality of the causal organism is low, a much smaller period than the one you mention should be sufficient to free the pastures.

RATSTAIL-GRASS.

"INQUIRER," Anatimo :—

I would be glad of any information about ratstail-grass, which is considered by some of my neighbours to be a good grass here. I grub out any I find on my property.

The Biologist :—

Ratstail-grass (*Sporobolus indicus*) has spread from the north and is now abundant on poor light soils, particularly in manuka country, as far south as Nelson and Marlborough. It was at one time largely used on this type of country in the north, producing a fair amount of herbage when young. It soon becomes very coarse, however, and wears down the teeth of sheep and cattle more quickly than any other grass in New Zealand. It is much inferior to danthonia, and is now generally looked upon as an undesirable plant.

ITCHING HEELS IN HORSES.

"X. Y. Z.," Kelso :—

I have a horse that is always rubbing its heels on the fences and breaking the wires, though there does not appear to be any signs of greasy heel. Can you tell me what treatment will prevent this rubbing and scratching ? I have tried washing with Jeyes fluid and also with sheep-dip.

The Live-stock Division :—

For itching heels in horses the following treatment may be recommended : Wash the legs thoroughly with lukewarm water and soap, using a dandy-brush to ensure removal of all dirt and scurf ; dry the legs with a rough towel, and allow the animal to stand for an hour or so to make sure that the hair and skin are perfectly dry ; then apply the following mixture by rubbing in with the hands—6 oz. sulphur, 12 oz. linseed-oil (or preferably olive-oil), 4 oz. oil of tar, and 2 oz. turpentine, mixed well together. It is advisable to keep the horses out of the mud and wet places as much as possible.

MATERIAL FOR HOTBEDS.

A. B. JONES, Nelson :—

As stable manure is now very hard to obtain for hotbed purposes, could you advise me of any other way of making large hotbeds, preferably with straw as a base ?

The Horticulture Division :

There is no known way of promoting fermentation in straw that would be suitable for hotbeds. Straw would also be detrimental if used in any combination with other material. Straw used as bedding for horses is trampled by their hoofs and the tissues broken. It also becomes saturated with urine. The urine, which contains a good deal of ammonia, starts fermentation, and the peculiar condition of the humus in the droppings continues it. There is no other combination resembling stable manure. In countries where deciduous trees are plentiful the leaves are used for hotbeds, but always in combination with stable manure. Spent hops from breweries have been tried, but are not satisfactory. Spent tan from tanneries is used in greenhouses ; it gives a gentle heat, but will not take the place of stable manure for ordinary purposes of a hotbed. We have heard of green grass being recommended, but this is ridiculous. If stable manure fails, the only sensible course is to provide a small house with heating-apparatus.

LIST OF QUALIFIED VETERINARY SURGEONS.

THE following list of qualified veterinary surgeons known to be residing in New Zealand is published for the guidance of stockowners and for general information. In the event of the name of any properly qualified veterinarian being omitted it is requested that he communicate with the Editor, giving particulars of his qualification, in order that the necessary steps may be taken for the inclusion of his name in the next published list.

*Ashe, G. G., M.R.C.V.S., Timaru.
*Barnes, A. W., M.R.C.V.S., Hastings.
*Barry, W. C., M.R.C.V.S., Auckland.
Bayley, A., M.R.C.V.S., Wanganui.
Begg, W. F., M.R.C.V.S., Te Awamutu.
*Blair, W. D., M.R.C.V.S., Invercargill.
*Blake, T. A., M.R.C.V.S., Masterton.
Brodie, A. M., M.R.C.V.S., Hastings.
*Broom, G., M.R.C.V.S., Gisborne.
*Burton, S., M.R.C.V.S., Hamilton.
Carbury, H. W., M.R.C.V.S., Blenheim.
Cockroft, J. E., M.R.C.V.S., Feilding.
*Collins, W. T., M.R.C.V.S., Wellington.
Crossley, F., M.R.C.V.S., Palmerston North.
*Cunningham, T., M.R.C.V.S., Oamaru.
*Danskin, J., M.R.C.V.S , Dunedin.
*Elphick, E. E., M.R.C.V.S., D.V.H., Wellington.
Glover, F., M.R.C.V.S., Hamilton.
*Hickman, A. J., M.R.C.V.S., Auckland.
Hankin, F. H., M.R.C.V.S., Point Chevalier.
*Haugh, P., M.R.C.V.S., Petone.
*Howard, E. C., M.R.C.V.S., Wanganui.
Johnson, A. A., F.R.C.V.S., Christchurch.
*Kerrigan, J., M.R.C.V.S., Christchurch.
Kyle, H. S. S., G.M.V.C. (Melb.), Templeton.
*Lawson, J. N., B.V.Sc. (Sydney), Wanganui.
*Lukey, E. J., B. V.Sc. (Melbourne), Christchurch.
*Lyons, J., M.R.C.V.S., Auckland.
*Mackenzie, A., D.V.S.M., M.R.C.V.S., Petone.
*Marsack, H. L., V.S. (Ontario), Auckland.
Marshall, D., M.R.C.V.S., Balclutha.
Martin, H. E., M.R.C.V.S., Christchurch.
McLeod, J., M.R.C.V.S., Christchurch.
*Meade, R. H., M.R.C.V.S., Palmerston North.
Miller, J., M.R.C.V.S., Invercargill.
*Paterson, A. M., M.R.C.V.S., Timaru.
Quinnell, W. C., M.R.C.V.S., Wellington.
†Reakes, C. J., M.R.C.V.S., D.V.Sc., Wellington.
*Reid, H. A., F.R.C.V.S., D.V.H., F.R.S.E., Wellington.
Ring, W. C., V.M.D. (Penn., U.S.A.), Ellerslie.
Siddall, E. L., M.R.C.V.S., Opotiki.
Simpson, C. S., M.R.C.V.S., Auckland.
*Snowball, W. D., M.R.C.V.S., Dunedin.
*Stafford, J., M.R.C.V.S., Christchurch.
‡Stapley, W., M.D., D.V.Sc., M.R.C.V.S., Cambridge.
Taylor, Alex., M.A., M.R.C.V.S., Lincoln.
Taylor, J. B., M.R.C.V.S., Waverley.
Taylor, W. G., M.R.C.V.S., New Plymouth.
Ward, J., M.R.C.V.S., Katikati.
*Wood, R. B., M.R.C.V.S., Waitara.
*Young, A. R., M.R.C.V.S., Wellington.

* Officers of the Live-stock Division, Department of Agriculture. † Director-General, Department of Agriculture, Wellington. ‡ Not now practising as a veterinary surgeon.

REGISTRATIONS OF FACTORIES, ETC., UNDER THE DAIRY INDUSTRY ACT: 30th April, 1922.

District.	Creameries (Butter).	Factories (Cheese).	Dual-plant Factories.	Private Dairies.		Packing-houses (Milled Butter).	Totals.
				Butter.	Cheese.		
Auckland	64	54	4	..	..	2	124
Taranaki	20	89	22	2	..	..	133
Wellington ..	17	59	7	..	..	2	85
Hawke's Bay ..	11	18	3	..	..	..	32
Nelson	6	4	1	..	..	7	18
Marlborough ..	4	7	..	..	..	..	11
Westland	7	3	..	..	..	..	10
Canterbury ..	12	15	2	..	..	..	29
Otago and Southland	15	81	..	..	..	..	96
Totals ..	156	330	39	2	..	11	538

Eight milk-powder factories (four whole-milk and four skim-milk plants), one condensed-milk factory, and three casein-drying factories are also established in the Dominion.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE next annual meeting of the Australasian Association for the Advancement of Science will be held at Wellington in January next. This will be the third time that the Association has met in New Zealand, the previous meetings having been held at Christchurch and Dunedin in 1891 and 1904 respectively. It is desired to make the agricultural and veterinary sections of the coming meeting outstanding features, and owing to the comparatively large number of professional agricultural officers employed by the Government and other bodies in New Zealand it is anticipated that the programmes of these sections will be filled to the limit. Authors of papers which they desire to read or have read at the meeting should send in the titles as soon as possible to the honorary secretary of the Agricultural Section, Mr. B. C. Aston, P.O. Box 40, Wellington, in order that suitable arrangements may be made to ensure a proper treatment for each contribution. It is desired that only the titles of papers should be sent in at first, but the whole of each paper, with an abstract prepared by the author, should be in the hands of the section secretary not later than 27th December next. The session of the association is fixed to begin on 9th January, 1922.

LAND FOR DISCHARGED SOLDIERS AND FOR GENERAL APPLICATION.

THE Department of Lands and Survey advises that the following lands will be made available for discharged soldiers during the next two months :—

Hawke's Bay Land District: Four sections in Te Kaihi, Glengarry, Te Kura, and Watea Settlements, of a total area of 684 acres, will be balloted for on 13th July. The land is suitable for dairying.

Canterbury Land District: Sixteen sections in Avonhead Settlement No. 2, total area 133 acres, will be balloted for on 20th July.

The following lands will be opened for general application during the next two months. For these lands, however, discharged soldiers will have preference in every instance where they apply :—

Auckland Land District: Four sections in Pukemapou Settlement, of a total area of 432 acres, will be offered on 26th June. Seven sections in Block IV, Waihi South Survey District, of a total area of 357 acres, are open for selection on 26th June. This land is suitable for dairying.

Hawke's Bay Land District: One section in Moeangiangi Survey District (Awa-o-Totara Block), of an area of 931 acres, will be offered on 11th July.

Wellington Land District: Two sections in Blocks III and XI, Whirinaki Survey District, of a total area of 2,285 acres, will be offered on 24th July. Two pastoral runs in Moawhango, Maungakaretu, and Ohinewairua Survey Districts, in areas of 1,234 acres and 1,600 acres, will be offered by public auction on 25th July.

Canterbury Land District: One pastoral run in Hewlings, Dalziel, and Gibson Survey Districts, of an area of 21,200 acres, will be offered for license on 18th July.

FORTHCOMING WINTER SHOWS.

Manawatu and West Coast A. and P. Association: Palmerston North (National Dairy Show), 20th to 23rd June.

Auckland A. and P. Association: Auckland, 3rd to 8th July.

Te Puke A. and P. Association: Te Puke, 21st July.

(Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.)